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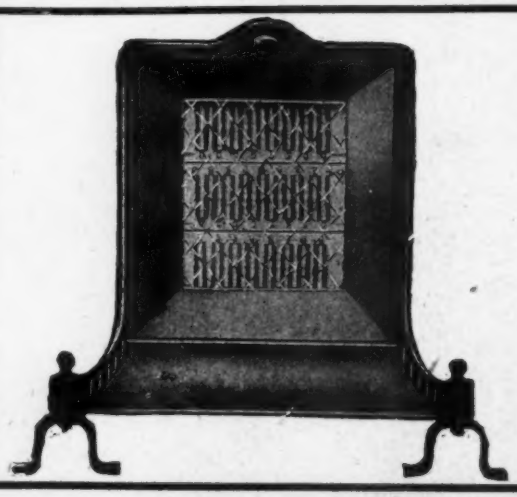

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AUTOMATIC HEAT CONTROL.

IN the process of cooking or heating, the desired result is achieved by raising bodies or air to a certain temperature, or series of temperatures, and maintaining them in that condition for a given time.

One is apt to take it for granted that this end can be attained by the steady release of heat energy at a constant rate; on the contrary, however, if the result aimed at is a steady temperature, irregular, and even intermittent, emissions of heat are generally required to compensate for losses, air changes, rise or fall in the temperature of the environment, and other circumstances.

Experiments on the heating of rooms in ordinary occupation by means of electric radiators controlled by thermostats have shown in a striking manner the irregular output of heat that is needed, and suggest that where any method of artificial heating is employed without automatic control, great waste occurs; even if care is taken to vary by hand from time to time the capacity of the heating elements in use, the result is not much more economical than the older method of throwing coal on the fire when the room becomes chilly, and opening the door when it becomes too hot.

A little consideration of this matter suggests that the supply of heating service to the consumer may often be split up into two components:—

The heavy work of maintaining rooms at a temperature substantially above that of the outside air by means of a *steady* delivery of heat energy which, on account of the large amount required, must be obtained from an inexpensive source; and, in addition, the lighter work of providing a smaller, and generally intermittent, supply of heat to compensate for variations and to keep the final room temperature at the required degree. The secondary heating, being capable of automatic control, should, and need only, be relied upon to provide a fraction of the total heating effect required, so that its cost becomes of less importance, particularly as by its use waste of the primary source of heat is diminished.

In short, fires or a hot-water system can be used in as regular and efficient a manner as their characteristics permit, being operated to maintain only the minimum temperature desired under normal circumstances, and supplemented by electric heaters with thermostatic regulation, which can be set to deliver heat at varying rates in answer to any demand arising from changes of outside temperature, ventilation, or the cooling effect produced by opening doors or neglect of fires.

In this way the inexpensive, but less easily regulated, source provides the larger and steady portion of the service, and the more expensive, but easily regulated, source takes care of the peaks and irregularities.

Experiments in maintaining store-rooms at steady temperatures by automatically-controlled electric heaters have shown in a striking manner the advantage and economy of the method, and it appears to offer valuable possibilities as a supplement to hot-water systems, particularly in large buildings, where the results of using central heating alone are often disappointing by reason of the very

uniformity of the heat delivery; the differences in the uses to which rooms may be put, unforeseen causes of heat loss, changes in use and in furnishing after the heating installation is complete, all contribute to the difficulty, and make a secondary and self-adjusting heat source most desirable.

The principle of mixed heating is worthy of investigation; many sources of waste or cheap heat have been neglected because they are intermittent, difficult to regulate, or insufficient to produce the temperature needed. By arranging to use them to the limit of their capacity, and making up any addition required by means of electricity, economy may often result. A notable example is at hand in the practice of steel makers, where in some cases the metal is preheated with coke, and the process is completed in the electric furnace. In household work there is still something to be done with the waste heat of range fires; even after hot water has been provided, the flue temperatures are high, and architects and engineers may well consider to what extent further heat can be recovered by means of tanks for storing warm water, or by built-in drying or hot cupboards, in which hay-box cooking can be carried out, or even arrangements made for operating jacketed electric ovens, in which electricity would often only be called upon to raise the temperature from, perhaps, 100° F. to the cooking point.

The problems of recovering waste heat from household fires, without destroying the necessary draught, and then providing a means of "topping up," are worthy of consideration, and any success which may be achieved will help to save fuel and reduce smoke, and may enable the supply engineer to secure yet another class of electricity-user able to pay a fair price and create a load of considerable diversity.

International Co-operation in Research.

If research is not to become a byword for inefficiency and ineptness, it is necessary to do a great deal quickly. At present there is a great deal of cackle, but the egg is not easy to discover. We refuse to admit that a manufacturing concern which equips itself with a chemical laboratory and a physical testing room has done all that is necessary to contribute to progress in this matter. Researchers are made, not born, and they must be trained to act on their own responsibility, with freedom from the ignorant fear which lies at the back of the evasiveness and non-committal attitude of which we nowadays hear so much.

The international aspect of the research problem recently received attention at a Conference held in Brussels. Before the war, many international bodies had grown up as a result of the necessity for the precise definition of standards, and for collecting scientific observations from stations all over the world, and those bodies, of which the International Electrotechnical Commission may be regarded as a typical example, were doing a great deal of very important work. The war interrupted international working, particularly as between scientists in mutually hostile countries, and it seems that in the Peace Treaty Germany has, with certain exceptions, agreed to withdraw from all conventions of a scientific or technical character.

The inference is that the old conventions are still in existence, including the victorious belligerents and the neutral powers. Emanating apparently from America, the idea of the allied countries seems to be to withdraw from such associations as may still exist, and to found new ones, the neutrals being, as *The Times* expresses it, "left in the air."

The objects of the International Research Council established by the Conference are defined to be:—

(*a*) To co-ordinate international efforts in the different branches of science and its applications.

(*b*) To initiate the formation of international associations or unions deemed to be useful to the progress of science.

(*c*) To direct international scientific action in subjects which do not fall within the province of any existing association.

(*d*) To enter, through the proper channels, into relations with the Governments of the countries adhering to the Council to recommend the study of questions falling within the competence of the Council.

The published summary of the Report tells us nothing of the identity of the scientists who assembled at Brussels, except that there were 17 representatives of Great Britain, including the Astronomers Royal of England and of Scotland, Profs. Lamb, Sherrington, and Turner, and Drs. Bateson and Glaisher; over 20 representatives from France; about the same number from the United States; twleve from Canada and one from New Zealand, while Belgium is stated to have been "naturally well represented in all branches of science." We are not told who chose these representatives. The Royal Society took some part, and, it seems, an important part in the business, but it appears at least doubtful if any other scientific association had anything to do with it.

We should certainly like the question cleared up from the electrical point of view, with special regard to the International Electrotechnical Commission, the field of whose labours has only as yet been scratched. Are we to assume that it has been dissolved? Or will it be superseded by, or absorbed in, one of the new "International Unions" which are being formed under the ægis of the International Research Council?

Service Men Cold-shouldered.

We have read the letter which appears in our "Correspondence" columns to-day from an able and experienced engineer who has been on active service for four years, with shame and indignation. Unfortunately it does not stand alone; others who have had a like experience have come to us and told us of the difficulties that they have met with in their endeavours to return to civil occupations.

We are fully aware of the fact that the conditions which at present prevail in the electrical industries are not favourable to the rapid absorption of men into civil employment; there is plenty of work to be done, but the uncertainties of the position with regard both to labour and to trading conditions in general hamper employers in embarking upon new contracts. We hope and believe that the situation will quickly improve, and that the nation will settle down to cope with the huge volume of work that is awaiting attention.

But that is not the subject of our complaint. What we strenuously protest against is the cold and unsympathetic reception accorded to so many ex-Service men—the men who have fought our battles and risked their lives in order to gain the victory by which this country and the whole of the British Empire has been rescued from ruin, from despicable servitude to a brutal race, and from ignominy unspeakable. We trust that the cases that we have met with are exceptional—but there are far too many of them, where there should be none. We refer particularly to examples of men who have been fortified with the assurance that they would be reinstated in their posts on their return, and to the numerous appointments which have been conferred upon men who have not seen military service, and who are actually in possession of suitable berths. We are not finding fault with the latter, most of whom have rendered invaluable service to their country by staying at their posts, and have undergone exceedingly arduous and wearing strains due to overwork and anxiety during the war. Our criticism is directed against those who, in filling appointments, have failed to give that preference to unemployed ex-Service men to which they are justly entitled; let these men first be restored to industrial service before men already employed are transferred. We ourselves have had occasion to fill vacancies on our staff; we have made it a rule that ex-Service men shall have the preference, and we have had no difficulty in satisfying our requirements from their ranks.

With regard to the former question—the reinstatement of men in their former posts—this is an obligation of honour, and to fail in its due discharge is in our opinion a disgraceful and unpatriotic breach of faith.

THE PRODUCTION OF ELECTRO-MEDICAL APPARATUS IN GREAT BRITAIN.

By CUTHBERT ANDREWS.

The history of the development in recent years of the electro-medical and X-ray industry in Great Britain is typical of that of many branches of British electrical engineering. Our manufacturers were far from allowing their foreign competitors to hold an uncontested market for this class of apparatus—on the contrary, in no country was electrical machinery of this nature better made or designed, nor were the firms interested lacking in ordinary business enterprise. But owing to what we can only term "modesty" on the part of the British worker he had failed to bring prominently before the world the achievements of the British School of Radiology; and thus the more cleverly advertised schools of work in Germany and other European countries were far better known than our own. In such affairs the demand for apparatus goes hand in hand with the announcement of so-called "original" radiological work, and thus the apparatus makers of Germany followed in the wake of the widely published announcements of their scientists. As a matter of fact, in no case has any country preceded Great Britain in the use of any important system of radiological work. Deep-seated therapeutic treatment, long-distance radiography, combined X-ray and radium therapy and other similar methods hailed as innovations, had all been practised unobtrusively in England before they were sent forth as novelties by Continental—and usually German—workers. But Great Britain has seen the error of her too modest attitude, and it is hoped that in future it will be possible to bring home to the world the fact that she has always been in the forefront of both theory and practice—in initiation of method as well as elaboration of appliances.

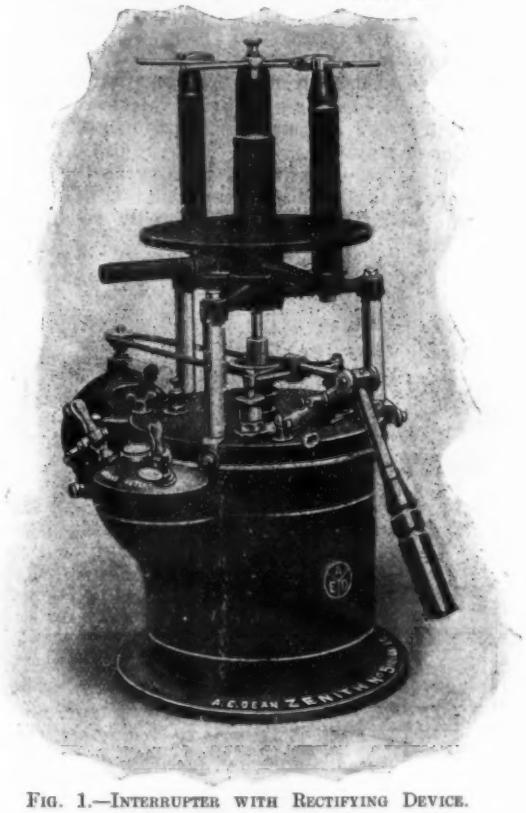

Fig. 1.—Interrupter with Rectifying Device.

On the outbreak of war it was seen immediately in this, as in many other fields of industry, how dependent England was upon outside sources for a large portion of her supplies. The capacity of the firms making X-ray and allied apparatus in Great Britain in 1914 was inadequate to meet the inevitable heavy requirements of the British Army and Navy. Fortunately, however, the position was realised with great rapidity, and there commenced a period of intense activity amongst the British manufacturers of X-ray and allied apparatus. Designs were evolved suitable to the problem to be faced, material was sought, labour was trained, and in some cases new factories were erected or adapted. Speedily the firms brought their output to the required point—the quality of their goods had never been in question—and within a space of months not only had the pressing needs of the British War Department been met, but quantities of apparatus had been sent to the Russian and other distant fronts. But the British firms were not content with this. Simultaneously they had been improving their quality and methods of production, and it stands to their lasting credit that since 1914 they have met the requirements not only of the British Army and Navy, British Red Cross, and the ordinary civil hospitals, but the demands of all the British Colonies, of Russia, of Serbia, of Roumania, and in some degree of Italy and Spain. And all this was done without State aid or material encouragement in any shape or form, and solely by those firms which were already established in this business before the Great War.

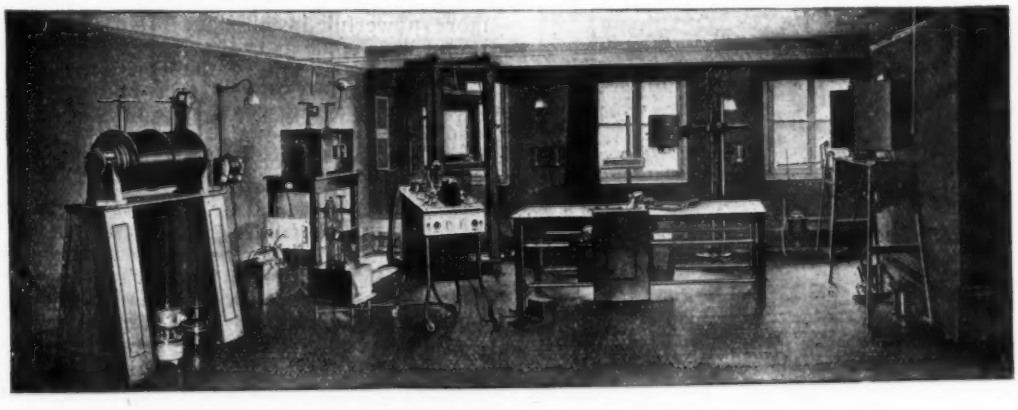

Fig. 2.—Typical Hospital X-ray Department.

The object of the foregoing remarks is to show that in this sphere of activity the British manufacturers have nothing to learn from those of any other country. British X-ray apparatus has been used in

every part of the globe, and under inconceivably difficult circumstances, and it has proved uniformly reliable and durable. The British X-ray manufacturer has always in mind the fact that the perfection of his apparatus may mean the saving of a life, and as everyone knows, thousands of lives have been spared during the war by the timely use of X-rays. Thus out of the hideous evil of the past four years comes some good, for now British industry can provide the

Fig. 3.—Snook Interrupterless Machine.

most up-to-date, well-finished and most dependable electrical apparatus of any country in the world.

The scope of this article is to show the general lines along which the British X-ray industry has advanced, and to review the wide field which is now

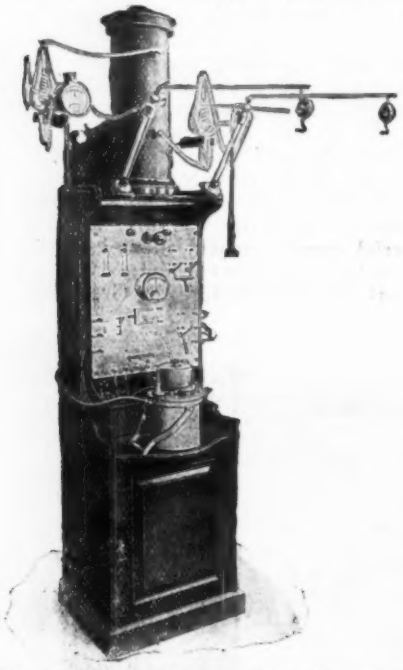

Fig. 4.—Compact Type of X-ray Apparatus.

covered by electro-medical apparatus. As far as possible medical terms have been avoided, our aim being rather to indicate the many uses of electricity as a curative power than to give exact details as to its method of application.

It will be interesting to mention first the type of apparatus which is in general use in this country for X-ray work. This consists essentially of an induction coil giving a discharge between points about 16 in. apart, together with a contact breaker or interrupter. The latter may be of the mercury jet or the Wehnelt type. The mercury jet form has undergone many modifications during the past few years, and the tendency now is to combine with it a rectifying device (fig. 1), one of the chief aims in all X-ray apparatus being to secure a unidirectional discharge through the tube. To these appliances is added an appropriate switchboard, and the mechanical conveniences for the examination of the patient and the practice of radiography and radiotherapy, these latter comprising such things as a couch, a vertical stand for examination with fluorescent screen, a stand having universal movements for adjusting the position of the tube (fig. 5) and other minor pieces of apparatus. The figure (fig. 2) shows a typical group of apparatus of this character.

The need in certain cases for instantaneous radiography has led to the adoption by some workers of heavy interrupterless machines having a capacity of the order of 8 kw. (fig. 3). This type of outfit is not, however, so popular in this country as the cheaper and more easily managed induction coil, although the gradual tendency is undoubtedly towards the

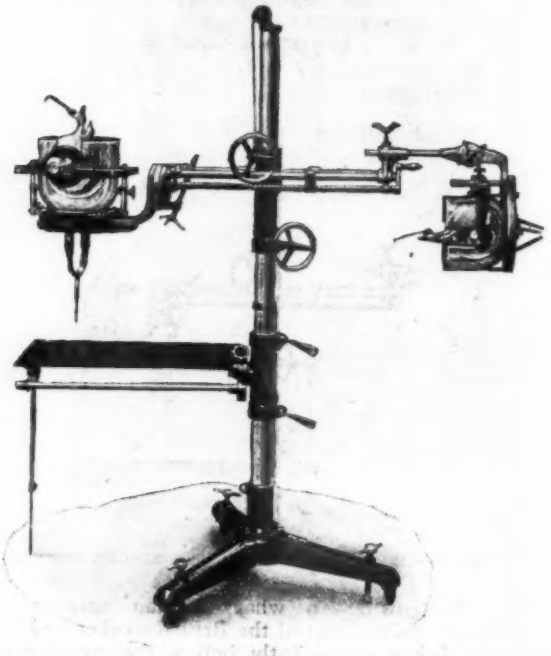

Fig. 5.—An Elaborate form of Stand for Supporting the X-ray Tube.

more powerful installation. This is fostered by recent developments in the uses to which X-rays are put, as, in addition to the ever-growing medical utilisation, an enormous field has been opened up by the application of the X-rays for the examination of metallic substances and other dense materials. By using a maximum form of discharge thicknesses can be penetrated which would have been considered impossible a few years ago; and it is claimed that cracks, blowholes, foreign substances, &c., can be demonstrated in steel or other metals by the uses of X-rays. It seems evident that the science of radio-metallurgy is destined to become a most important part of the future development of manufacturing processes of all kinds, and some further particulars regarding metal radiography are given below.

It is interesting to see what widely varying X-ray plant has been evolved for different purposes. At one end of the scale we have the portable set, in which every part is made as small, light and compact as possible, so that it may be transported from place to place in the smallest kind of vehicle, or, mounted on a trolley, can be wheeled through a

hospital ward for use at the bedside. Next we have the more standard set suitable for permanent erection in the hospital or private operating room as in figs. 2 and 4. Then we have the field hospital set, which is practically a complete X-ray department, comprising a shelter with couch, X-ray installation, accumulators, dark room, appliances for steroscopic examination, &c., all contained in a specially built motor van. Obviously such equipments have been of inestimable service during the war, enabling rapid and accurate work to be done in situations where no fixed apparatus was practicable.

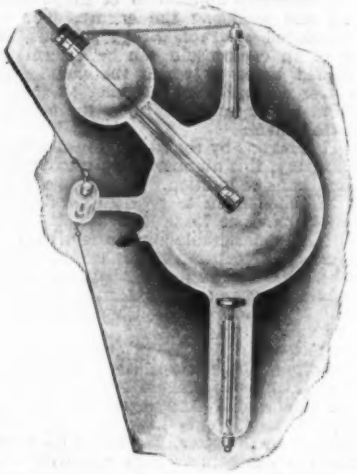

Fig. 6.—Water-cooled X-ray Tube.

It is scarcely possible to enumerate in this article the many subsidiary appliances now in regular use in connection with X-ray work, but some idea will be afforded of the growth of the science when it is stated that amongst the apparatus installed in a good-sized hospital, in addition to the plant for producing the discharge, will be found arrangements for taking stereoscopic pictures and also for viewing these, either as negatives or positives; appliances for determining the positions of foreign bodies, such as bullets, &c., in the patient; attachments allowing of the visual examination of the living body, in order to follow the processes of digestion, &c., and the making of drawings of the actual shadows thrown. There is also experimental apparatus in existence which aims at allowing surgical work to be carried out while the operator views the patient stereoscopically throughout the actual operation.

One of the most important factors in connection with X-ray work is the production of efficient tubes, and the progress made in this direction in England has been of a notable kind. Prior to the war the glass for X-ray tubes was imported from Germany;

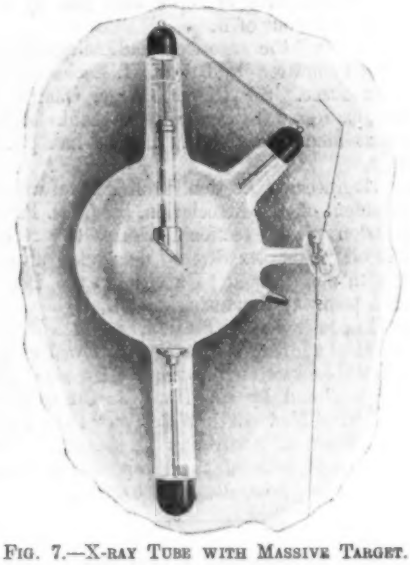

Fig. 7.—X-ray Tube with Massive Target.

but at the present time an absolutely efficient material is manufactured in London, and X-ray tubes are produced in large numbers and of a high degree of excellence. British manufacturers are now in a position to offer considerable quantities of tubes for export, and it is hoped that a large part of the business formerly done by Germany will be secured for the home factories. All the types of X-ray tubes in general use are being made, including large and small tubes with platinum or tungsten targets of medium and heavy weights (fig. 7); water cooled tubes (fig. 6), radiator tubes, therapeutic models, valve tubes of various types, and so on.

(To be continued.)

THE BRITISH ASSOCIATION.—I.

The eighty-seventh annual meeting of the British Association for the Advancement of Science opened on Tuesday morning in the Municipal College at Bournemouth. "Three years of anxiety and stress," to use the opening words of the President's address, have passed since the last meeting, which was held at Newcastle in 1916. And now after the great upheaval, "the elemental conditions of organisation of the world are still in flux, and we have to consider how to influence and mould the recrystallisation of these elements into the best forms and most economic rearrangements for the benefits of civilization." Conscious that it is capable of exerting a great influence in guiding the nation towards advancement in the Sciences in the most general sense, the Association has now resumed its annual proceedings. Its 12 Sections are meeting, for the first time we believe, in one set of buildings, in a fashionable seaside resort, where the season is still at its height, a section of the Fleet—the *Barham* and the *Malaya*—in the Bay, and Jack in consequence ashore, and where a great international flying race on Wednesday took precedence as the greatest public event of the week. At the time of writing the weather is beautiful, and the general attractions are numerous, two circumstances which will reconcile the most serious among the members to the fact that the sectional proceedings in nearly every case will not extend into the afternoon.

Contrary to the usual custom, the meetings opened sectionally, instead of with the great inaugural meeting at which the president delivered his address. Therefore, at 10 a.m. on Tuesday, after the usual reunion and handshakings in the reception room and contiguous departments, members turned their steps to one or other of the Section rooms. Section "A" (Mathematical and Physical Science) opened the ball, "G" (Engineering) deferring its proceedings until 11 o'clock, in order that the members of both Sections might together listen to the address of Prof. A. Gray, F.R.S., (sectional president), on lessons of the war. At 11 o'clock the Section turned its attention to the report of the Committee on Wireless Telegraphy, while members of "G" settled down to hear the address of their sectional president, Prof. J. E. Petavel, F.R.S., who reviewed engineering and science during the war, and referred to the subject of industrial and economic reconstruction.

In the Chemical Section, Prof. P. Phillips Bedson, D.Sc., (sectional president), briefly reviewed some of the features of the rise and development of the "Periodic Law."

In the Agricultural Section, Dr. Charles Mercier was to have read a paper and led a discussion on "The Electrical Treatment of Seeds," but his tragic death, last week, necessitated a substitute stepping into the gap. Mr. Blackburn, who had been associated with the deceased gentleman for some years, said that the doctor had long been interested in the subject, but he had not prepared any special paper; therefore he (Mr. Blackburn) must make it plain that in dealing with the matter he was putting forward his own views. Some discussion followed, in the course of which it transpired, as we should have anticipated, that opinions regarding electrification of seeds were not by any means unanimously in favour of it.

In Section "A" the report on Radiotelegraphic Investigations was submitted by Dr. W. H. Eccles, the Secretary of the Committee. Sir Oliver Lodge, Chairman of the Committee, expressed the Committee's thanks to Dr. Eccles for the vast amount of work that he had put into the proceedings.

In the Engineering Section, Prof. Petavel was supported by the president of the Association, Sir Chas. Parsons. At the conclusion of the sectional address the report of the Committee on "Complex Stress" demanded attention, and the afternoon was devoted to a visit to the Bournemouth Corporation tramway generating station.

In the Economic Science Section, Sir Hugh Bell delivered the presidential address, and he was followed by the Right Hon. F. Huth Jackson on "National Alliance of Employers and Employed," and by the Hon. Sir Chas. Wade, K.C., Agent-General of New South Wales, on "Price Fixing, with Special Reference to Australian Experience." The chairman showed that both of these papers were very closely connected, and they were discussed together.

Presidential Address.

By the Hon. Sir Charles A. Parsons, K.C.B., F.R.S.

(*Abstract.*)

Three years of anxiety and stress have passed since the last meeting of the British Association. We are gathered together at a time when, after a great upheaval, the elemental conditions of organisation of the world are still in flux, and we have to consider how to influence and mould the recrystallisation of these elements into the best forms and most economic rearrangements for the benefit of civilisation. That the British Association is capable of exerting a great influence in guiding the nation towards advancement in the Sciences and Arts in the most general sense there can be no question, and of this we may be assured by a study of its proceedings in conjunction with the history of contemporary progress.

This year marks the hundredth anniversary of the death of James Watt, and in reviewing the past, it appears that England has gained her present proud position by her early enterprise and by the success of the Watt steam engine, which enabled her to become the first country to develop her resources in coal, and led to the establishment of her great manufactures and her immense mercantile marine. Watt gave to the world an engine which consumed from five to seven pounds of coal per horse-power hour, or one-quarter of the fuel previously used by any engine. With this consumption of fuel its field under the conditions prevailing at the time was practically unlimited. To the Watt engine consuming from five to seven pounds of coal per horse-power, mankind owes the greatest permanent advances in material welfare recorded in history.

The turbine of to-day carries the expansion of steam much further than has been found possible in any reciprocating engine, and owing to this property it has surpassed it in the economy of coal, and it realises to the fullest extent Watt's ideal of the expansion of steam from the boiler to the lowest vapour pressure obtainable in the condenser.

Among the minor improvements which in recent years have conduced to a higher efficiency in turbines are the more accurate curvature of the blades to avoid eddy losses in the steam, the raising of the peripheral velocities of the blades to nearly the velocity of the steam impinging upon them, and details of construction to reduce leakages to a minimum. In turbines of 20,000 to 30,000 H.P. 82 per cent. of the available energy in the steam is now obtainable as brake H.P.; and with a boiler efficiency of 85 per cent. the thermodynamic efficiency from the fuel to the electrical output of the alternator has reached 23 per cent., and shortly may reach 28 per cent., a result rivalling the effciency of internal-combustion engines worked by producer gas.

Brief reference must be made to the important work of one of the committees of the British Association appointed in 1908, under the chairmanship of the late Sir William Preece, for the investigation of gaseous explosions, with special reference to temperature. One investigation in particular has proved to be a guiding star to the designers and manufacturers of internal combustion engines in this country. The members of the committee more directly associated with this particular investigation were Sir Dugald Clerk, Prof. Callender, and the late Prof. Bertram Hopkinson.

The investigation showed that the intensity of the heat radiated by the incandescent gases to the walls of the cylinder of a gas engine increases with the size of the cylinder, the actual rate of this increase being approximately proportional to the square root of the depth of the radiating incandescent gas; the intensity was also shown to increase rapidly with the richness of the gas. It suffices now to say that the heat in a large cylinder with a rich explosive mixture is so intense that the metal eventually cracks. The investigation shows why this occurs, and by doing so has saved enormous sums to the makers of gas and oil engines in this country, and has led them to avoid the large cylinder, so common in Germany before the war, in favour of a multiplicity of smaller cylinders.

Probably the most interesting development during the war has been the extensive application of sound-listening devices for detecting and localising the enemy. The sound-ranging apparatus developed by Prof. Bragg and his son, by which the position of an enemy gun can be determined from electrically recorded times at which the sound wave from the gun passes over a number of receiving stations, has enabled our artillery to concentrate its fire on the enemy's guns, and often to destroy them.

During 1917 locations by sound-ranging reached about 30,000 for the whole army, this number being greater than that given by any other means of location. A single good set of observations could be relied upon to give the position of an enemy gun to about 50 yards at 7,000 yards range. It could also be carried on during considerable artillery activity.

The apparatus for localising noises transmitted through the ground has been much used for the detection of enemy mining and counter-mining operations. Acoustic tubes, microphones, and amplifying valves have been employed to increase the volume of very faint noises.

Of all the physical disturbances emitted or produced by a moving submarine, those most easily detected, and at the greatest distance, are the pressure waves set up in the water by vibrations produced by the vessel and her machinery. A great variety of instruments have been devised during the war for detecting these noises, depending on microphones and magnetophones of exceedingly high sensitivity. Among them may be particularly mentioned the hydrophones devised by Capt. Ryan and Prof. Bragg, being adaptations of the telephone transmitter to work in water, instead of air. These instruments, when mounted so as to rotate, are directional, being insensitive to sound waves whose front is perpendicular to the plane of the diaphragm, and giving the loudest sound when the diaphragm is parallel to the wave front.

Another preferable method for determining direction is to use two hydrophones coupled to two receivers, one held to each ear. This is called the binaural method, and enables the listener to recognise the direction from which the sound emanates.

When the vessel is in motion or the sea is rough the water noises from the dragging of the instrument through the water and from the waves striking the ship drown the noises from the enemy vessel, and under such conditions the instruments are useless. The assistance of eminent biologists was of invaluable help at this juncture. Experiments were made with sea-lions by Sir Richard Paget, who found that they have directional hearing under water up to speeds of six knots. Also Prof. Keith explained the construction of the hearing organs of the whale, the ear proper being a capillary tube, too small to be capable of performing any useful function in transmitting sound to the relatively large aural organs, which are deep set in the head. The whale therefore hears by means of the sound waves transmitted through the substance of the head. It was further seen that the organs of hearing of the whale to some degree resembled the hydrophone.

The course now became clear. Hollow towing bodies in the form of fish or purpoises were made of celluloid, varnished canvas, or very thin metal, and the hydrophone suitably fixed in the centre of the head. The body is filled with water, and the cable towing the fish contains the insulated leads to the observer on board the vessel. When towed at some distance behind the chasing ship disturbing noises are small, and enemy noises can be heard up to speeds of 14 knots, and at considerable distances. Thermionic amplifying valves have been extensively used, and have added much to the sensitiveness of the hydrophone in its many forms.

After the loss of the *Titanic* by collision with an iceberg, Lewis Richardson was granted two patents in 1912 for the detection of above-water objects by their echo in the air, and underwater objects by the echo transmitted through the water.

The echo method of detection was not, however, practically developed until French and English scientists, realising its importance for submarine detection, brought the apparatus to a high degree of perfection and utility shortly before the armistice. Now, with beams of high-frequency sound waves, it is possible to sweep the seas for the detection of any submerged object, such as icebergs, submarines, surface vessels, and rocks; they may also be used to make soundings. It enables a chasing ship to pick up and close in on a submarine situated more than a mile away.

The successful development of sound-ranging apparatus on land led to the suggestion by Prof. Bragg that a modified form could be used to locate under-water explosions. It has been found that the shock of an explosion can be detected hundreds of miles from its source by means of a submerged hydrophone,

and that the time of the arrival of the sound wave can be recorded with great precision. At the end of the war the sound-ranging stations were being used for the detection of positions at sea, required for strategical purposes. The same stations are now being used extensively for the determination of such positions at sea as light-vessels, buoys which indicate channels, and obstructions such as sunken ships. By this means ships steaming in fog can be given their positions with accuracy for ranges up to 500 miles.

Among the many other important technical systems and devices brought out during the war which will find useful application under peace conditions as aids to navigation I may mention directional wireless, by which ships and aircraft can be given their positions and directed.

Leader gear, first used by the Germans to direct their ships through their minefields, and subsequently used by the Allies, consists of an insulated cable laid on the bottom of the sea, earthed at the further end, and through which an alternating current is passed. By means of delicate devices installed on a ship, she is able to follow the cable at any speed with as much precision as a railless electric 'bus can follow its trolley wire. Cables up to 50 miles long have been used, and this device promises to be invaluable to ships navigating narrow and tortuous channels and entering or leaving harbours in a fog.

The supply and use of electricity has developed rapidly in recent years. For lighting it is the rival of gas, though each has its advantages. As a means of transmitting power over long distances it has no rival. It is rapidly superseding locally generated steam-power, and is a rival to the small and moderate-sized gas and oil engines. Steam turbines are now exclusively used in large generating stations, because of their smaller cost and greater economy in fuel. At the end of last year the central electric stations in the United Kingdom contained plant aggregating 2¾ million kilowatts, 79 per cent. of which was driven by steam turbines.

Much discussion has taken place as to the most economical size of generating stations, their number, the size of the generating units, and the size of the area to be supplied. On the one hand, a comparatively small number of very large or super-stations, instead of a large number of moderate-sized stations dotted over the area, results in a small decrease in the cost of production of the electricity, because in the super-stations larger and slightly more economical engines are employed, while the larger stations permit of higher organisation and more elaborate labour-saving appliances. Further, if in the future the recovery of the by-products of coal should become a practical realisation as part of the process in the generation of electricity, the larger super-stations present greater facilities than the smaller stations. On the other hand, super-stations involve the transmission of the electricity over greater distances, and consequently greater capital expenditure and cost of maintenance of mains and transmission apparatus, and greater electrical transmission losses, while the larger generating unit takes longer to overhaul or repair, and consequently a larger percentage of spare plant is necessary.

The greatest element in reducing the cost of electricity is the provision of a good load factor; in other words, the utilisation of the generating plant and mains to the greatest extent during the twenty-four hours of each day throughout the year. This is a far more important consideration than the size of the station, and it is secured to the best advantage in most cases by a widespread network of mains, supplying a diversity of consumers and uses, each requiring energy at different times of the day.

There is no golden rule to secure cheap electricity. The most favourable size, locality, and number of generating stations in each area can only be arrived at by a close study of the local conditions, but there is no doubt that, generally speaking, to secure cheap electricity a widespread network of mains is in most cases a very important, if not an essential, factor.

Municipal and company-owned generating stations have been nearly doubled in capacity during the war to meet the demand from munition works, steel works, chemical works, and for many other purposes. The provision of this increased supply was an enormous help in the production of adequate munitions. At the commencement of the war there were few electric-steel furnaces in the country; at the end of last year 117 were at work, producing 20,000 tons of steel per month, consisting chiefly of high-grade ferro alloys used in munitions.

The Future.

The nations which have exerted the most influence in the war have been those which have developed to the greatest extent their resources, their manufactures, and their commerce. As in the war, so in the civilisation of mankind. But, viewing the present trend of developments in harnessing water-power and using up the fuel resources of the world for the use and convenience of man, one cannot but realise that, failing new and unexpected discoveries in science, such as the harnessing of the latent molecular and atomic energy in matter, as foreshadowed by Clerk Maxwell, Kelvin, Rutherford, and others, the great position of England cannot be maintained for an indefinite period. At some time more or less remote—long before the exhaustion of our coal—the population will gradually migrate to those countries where the natural sources of energy are the most abundant.

The amount of available water-power in the British Isles is very small as compared with the total in other countries. According to the latest estimates, the total in the British Isles is under 1¼ million horse-power, whereas Canada alone possesses over 20 millions, of which over 2 millions have already been harnessed. In the rest of the British Empire there are upwards of 30 millions and in the remainder of the world at least 150 millions, so that England herself possesses less than 1 per cent. of the water-power of the world. Further, it has been estimated that she only possesses 2¼ per cent. of the whole coal of the world.

I have said that England owes her modern greatness to the early development of her coal. Upon it she must continue to depend almost exclusively for her heat and source of power, including that required for propelling her vast mercantile marine. Nevertheless, she is using up her resources in coal much more rapidly than most other countries are consuming theirs, and long before any near approach to exhaustion is reached her richer seams will have become impoverished, and the cost of mining so much increased that, given cheap transport, it might pay her better to import coal from richer fields of almost limitless extent belonging to foreign countries, and workable at a much lower cost than her own.

Let us endeavour to arrive at some approximate estimate of the economic value of the principal sources of power. The present average value of the royalties on coal in England is about 6d. per ton, but to this must be added the profit derived from mining operations after paying royalties and providing for interest on the capital expended and for its redemption as wasting capital. After consultation with several leading experts in these matters, I have come to the conclusion that about 1s. per ton represents the pre-war market value of coal in the seams in England.

It must, however, be remembered that, in addition, coal has a considerable value as a national asset, for on it depends the prosperity of the great industrial interests of the country, which contribute a large portion of the wealth and revenue. From this point of view the present value of unmined coal seems not to have been sufficiently appreciated in the past, and that in the future it should be better appraised at its true value to the nation.

This question may be viewed from another aspect by making a comparison of the cost of producing a given amount of electrical power from coal and from water-power. Assuming that one H.P. of energy maintained for one year had a pre-war value of £5, and that it requires about 8 tons of average coal to produce it, we arrive at the price of 6s. 3d. per ton, *i.e.*, crediting the coal with half the cost. The capital required to mine 8 tons of coal a year in England is difficult to estimate, but it may be taken approximately to be £5, and the capital for plant and machinery to convert it into electricity at £10, making a total of £15. In the case of water-power the average capital cost on the above basis is £40, including water rights (though in exceptionally favoured districts much lower costs are recorded).

From these figures it appears that the average capital required to produce electrical power from coal is less than half the amount that is required in the case of water-power. The running costs, however, in connection with water-power are much less than those in respect of coal. Another interesting consideration is that the cost of harnessing all the water-power of the world would be about 8,000 millions, or equal to the cost of the war to England.

Dowling has estimated the total coal of the world as over seven million million tons, and whether we appraise it at 1s. or more per ton its present and prospective value is prodigious. For instance, at 6s. 3d. per ton it amounts to nearly one hundred times the cost of the war to all the belligerents.

In some foreign countries the capital costs of mining are far below the figures I have taken, and, as coal is transportable long distances and, generally speaking, electricity is not so at present, therefore it seems probable that capital will in the immediate future flow in increasing quantity to mining operations in foreign countries rather than to the development of, at any rate the more difficult and costly, water-power schemes. When, however, capital becomes more plentiful the lower running costs of water-power will prevail, with the result that water-power will then be rapidly developed.

In my address to Section B in 1904 I discussed the question of sinking a shaft to a depth of twelve miles, which is about ten times the depth of any shaft in existence. The estimated cost was £5,000,000, and the time required about eighty-five years.

The method of cooling the air-locks to limit the barometric pressure on the miners and other precautions were described, and the project appeared feasible. In limestone a depth of fifteen miles is probably practicable, and in granite a depth of thirty miles might be reached.

Little is at present known of the earth's interior, except by inference from a study of its surface, upturned strata, shallow shafts, the velocity of transmission of seismic disturbances, its rigidity and specific gravity, and it seems reasonable to suggest that some attempt should be made to sink a shaft as deep as may be found practicable and at some locality selected by geologists as the most likely to afford useful information.

When we consider that the estimated cost of sinking a shaft to a depth of twelve miles, at present-day prices, is not much more than the cost of one day of the war to Great Britain alone, the expense seems trivial as compared with the possible knowledge that might be gained by an investigation into this unexplored region of the earth. It might, indeed, prove of inestimable value to Science, and also throw addi-

tional light on the internal constitution of the earth in relation to minerals of high specific gravity.

In Italy, at Lardarello, bore holes have been sunk, which discharge large volumes of high-pressure steam, which is being utilised to generate about 10,000 horse-power by turbines. At Solfatara, near Naples, a similar project is on foot to supply power to the great works in the district. It seems, indeed, probable that in volcanic regions a very large amount of power may be, in the future, obtained directly or indirectly by boring into the earth, and that the whole subject merits the most careful consideration.

The possibility of the uncontrolled use on the part of a nation of the power which Science has placed within its reach is so great a menace to civilisation * that the ardent wish of all reasonable people is to possess some radical means of prevention through the establishment of some form of wide and powerful control. Has not Science forged the remedy, by making the world a smaller arena for the activities of civilisation, by reducing distance in terms of time? Alliances and unions, which have successfully controlled and stimulated republics of heterogeneous races during the last century, will therefore have become possible on a wider and grander scale, thus uniting all civilised nations in a great League to maintain order, security, and freedom for every individual and for every State and nation liberty to devote their energies to the controlling of the great forces of Nature for the use and convenience of man, instead of applying them to the killing of each other.

Engineering Section.

Presidential Address by

PROF. J. E. PETAVEL, D.Sc., F.R.S. (*Abstract.*)

Engineering and Science during the War.—To summarise adequately the part played by engineering in the war would constitute a task far beyond the power of the writer or the scope of the present address. The fate of nations in war or peace is primarily determined by moral, intellectual, and physical attributes; but, under modern conditions, these forces can find efficient application, only through the agency of science and engineering. Before the end of the war this country had become transformed into one vast factory, every department of which required the services of trained engineers. The urgent necessity for an output of munitions vastly in excess of any previous production made centralisation and standardisation essential, and involved a complete revolution in workshop practice. The Ministry of Munitions was responsible for the formation of the required organisations, and guided the transformation of industrial conditions, and, when the dilution of skilled labour became inevitable, the technical engineer designed the machinery and devised the methods which made efficient work possible. Credit is due to the unions for the concessions made; greater credit to the women for their enthusiastic response to the call.

The Ministry of Munitions was created in May, 1915, and by 1918 a large reserve of munitions had been established, the expenditure being limited only by difficulties of transport at the Front. The maximum expenditure of ammunition was reached one day in October of that year, when 900,000 shells, weighing 40,000 tons, were fired. The total number of guns manufactured during the war was 20,000, and over 200,000 machine guns had been delivered by November, 1918. The Ministry of Munitions took charge also of the production of aircraft, which were ultimately turned out at the rate of 4,000 per month; later the provision of motor transport was in addition placed under its control. Finally, our production of "poison gas," for which this Ministry was responsible, rose during the last few months of the war to several thousand tons a month. Among the inventions which have had an influence on military operations I will mention only three as typical of three distinct classes: Tanks were first used in 1916. The tank was the product of careful design and experiment, and the outcome of the co-operation of several engineers with special knowledge. Sound-ranging introduced the complex methods and delicate instruments of physical research into the trenches, and, against all precedents, proved them to be reliable and practical under the most adverse conditions. The Stokes gun, on the other hand, superseded all other trench mortars by simplicity of design and of manufacture, and convenience in handling; 20,000 of these guns were used during the war.

On August 4th, 1914, the Government assumed control of the railway systems in this country, but the working and management was left in the hands of the railway officials, and to them is due the smooth working of the lines during a long period of exceptional difficulty. British engineers, civil or military, have been responsible for the transport through France, and large numbers of engines were sent across the Channel and miles of track were taken up in England and relaid in France. Road transport was organised on an unprecedented scale, and 100,000 new vehicles were delivered. A network of narrow-gauge railways was carried right up to the trenches, and numerous new roads, railway lines, and bridges constructed. Railway construction formed an important factor in connection with the advances in Mesopotamia and Palestine; in the latter case the entire water supply had for a long period to be drawn from the Egyptian base through a specially laid pipe-line. The armies were primarily dependent upon sea transport for their food and equipment. This service, organised by the Navy, culminated in the unique effort which brought American troops at the rate of 300,000 per month. Among the notable new departures the cross Channel train ferry and the portable steel bridges, principally of the Inglis type, should be specially mentioned.

At the outbreak of war the Navy was ill-prepared with regard to anti-submarine defence and mining, but during 1915 the depth-charge and the paravane were developed by the naval experimental department at Portsmouth. The merit of the former resides in the simplicity, safety, and reliability of the mechanism. The secret of the latter lies in the stabilising mechanism, which enables it to keep its position when the ship is running at high speeds. The paravane enabled most ships to pass unscathed through a mine-field, and in a slightly modified form it served to seek out and destroy submarines under the water.

Sound location proved to be one of the most valuable inventions developed by the Board of Invention and Research. Mine construction, laying and sweeping formed the object of many successive improvements. Mines of special construction, which cannot be swept by ordinary means and which explode without actual contact, were used in large numbers in 1918. Many of the newer fighting units of the Navy were designed for speeds far in excess of anything that had been previously contemplated; the attainment of the required horse-power was rendered possible by improvements in boiler construction, by the development of oil-firing, and by the invention of the geared turbine. At the present time the horse-power of some of the fastest destroyers equals that of any pre-war Dreadnoughts. Numbers of strange craft were designed for special purposes. The latest and perhaps the strangest craft was the submarine fitted with a heavy calibre gun which could be fired when all but the muzzle was submerged.

The rapid progress and expansion of aeronautical science and construction is perhaps the most remarkable achievement of engineering during the war. The number of aeroplanes available in 1914 was under 200; the number ultimately required proved to be more than 3,000 per month. The aeroplanes which were sent out with the Expeditionary Force in 1914 had a maximum speed of some 80 miles per hour, a rate of climb at ground level of 300 or 400 ft. per minute; they were equipped with engines of 60 to 100 H.P. In 1918 the fast machine had a maximum speed of 140 miles per hour, a rate of climb at ground level of 2,000 ft. per minute; the largest machines were equipped with power plant developing over 1,300 H.P. The maximum height attainable had increased from 5,000 to 25,000 ft. The Atlantic flight has given the measure of the success achieved in the design of long-range bombing machines. The bulk of production of aero-engines presented grave difficulties. Every part had to be made to close limits so as to be interchangeable, and it was necessary to maintain the highest quality with the minimum amount of skilled labour. For a period the supply of magnetos was both inadequate and unsatisfactory, and it became essential for us to build up a new industry on the results of careful research and experiment. The fact that under these circumstances a total of 8 million H.P. was produced during the last twelve months of the war represents one of the greatest achievements of engineering organisation. Most of the best seaplanes in use in 1918 had a total weight of 4 or 5 tons each, a speed of nearly 100 miles, and engines of about 700 H.P. One type was of sufficient size to carry an 18 in. torpedo. Airships proved to be of great importance in connection with naval work. The SSZ had a speed of 50 miles and a gross lift of about 2 tons; the North Sea type a lift of 11 tons and a speed of 60 miles. Compared with the achievements in other directions the record of British work in connection with the development of rigid airships is not entirely satisfactory. In this field, where consistent policy and firmness of purpose were essential, the Admiralty vacillated strangely.

What is popularly known as an invention, or an idea of revolutionary importance emanating from one person, has played relatively little part in the recent development of aeronautics. Success has been due to systematic investigation and to the combined effort of many scientific workers, trained designers, and practical constructors. With some exceptions the same holds true in the case of engine construction. Inventions there have been, 8,000 are duly recorded in the files of the Air Inventions Committee, but equipment and armament and accessories appear to have offered most scope for brilliant new departures. Several inventions notably influenced the course of the war. The successful manufacture of incendiary bullets put an end to the Zeppelin raids, tracer bullets increased the accuracy of aim, and synchronising gear made it possible to fire through the propeller at the rate of nearly 1,000 rounds per minute. A satisfactory self-sealing petrol tank was manufactured. Much ingenuity was displayed in connection with bomb sighting and navigational instruments. Wireless telephony and directional wireless were introduced. A reliable turn indicator and improved compass made accurate navigation through clouds possible. Armoured aeroplanes were constructed; special machines were also designed for carrying 37 mm. quick-firing guns for use at the Front and against submarines; these guns fired a 1½-lb. high explosive shell.

The above outline of engineering activities during the war is both incomplete and imperfect. It may, however, serve to emphasise and illustrate the two features which characterised the period and made victory possible, viz., large production, obtained by organisation, standardisation, and co-operation;

* For instance, it might some day be discovered how to liberate instantaneously the energy in radium, and radium contains 2½ million times the energy of the same weight of T.N.T.

and rapid progress resulting from the stimulus to research and invention, and the immediate application of the results obtained.

Industrial and Economic Reconstruction.—The peace declaration is the opening of a new act in the world's greatest drama, and the events of the next few years will decide the fate of many generations. It is, therefore, the duty of each one of us to attempt to understand the transformation which is going on, and influence it in the right direction.

The principal feature of the day is the insistent craving for better and easier conditions of life; in popular language this is quite inaccurately expressed by a demand for higher wages and less work. The two aims are far from identical; in fact, in some respects they are contradictory. The total remuneration received by a nation is measured by its production. On the other hand, the share received by a class or an individual is capable of adjustment within certain limits. Thus any class may increase its remuneration either by increasing the total production or by decreasing the remuneration received by the other classes. No such limitations exist, however, with regard to the face value of the wages paid; by Act of Parliament all wages might be increased arbitrarily twentyfold, but as a result the cost of living would rise in a similar ratio.

Incalculable harm has been done by ignorance and wilful misrepresentation. The actual facts so far as engineering is concerned will be found in the address of my predecessor in this chair. On an average in pre-war days the share of the capitalist was one-ninth that of the workman. With regard to coal, for each ton raised 19s. 5½d. goes for labour and a total of 2s. is paid as royalties, owners' profits, and owners' compensation. These facts, though clearly established, are not easily credited by the working man. A real improvement in material welfare is necessarily associated with increased production. The needs of mankind are many, its desires are unlimited, and for this reason general over-production need never arise. Many circumstances may, however, lead to uneven balance. The instability is fostered and increased by speculation, and, although it forms the most powerful check on national prosperity, no serious effort has yet been made to apply a remedy. I am inclined to think that two of the most important problems of our time relate to economic balance and increased production. The solution in the former case is dependent on the statesman, the economist, and the business man; in the latter, on the combined efforts of various branches of applied science, and more especially on engineering.

Increased production does not necessarily imply harder work or longer hours; it can be secured by improvements in method and machinery, but only with the willing co-operation of all concerned. Before the war the Americans were far ahead of us in standardisation and specialised machinery. During the war we adopted and developed these methods. As a result, although the cost of all materials increased considerably, although the wages more than doubled and the profits were more than adequate, the cost was in many cases reduced. The importance of standardisation has been fully realised by the manufacturers of this country, and as a result we may hope to see a general reduction in cost. The economic value of an individual depends exclusively on the nature, quality, and quantity of his output, and his remuneration should correspond to his economic value. The rule is simple, its application would solve most of the problems which vex the present generation, but no scheme has yet been evolved to make its application possible. There can be no doubt that in this respect our present system is a complete failure.

The minimum wage is beneficial in so far as it prevents sweating, but the man whose value is a fraction below the minimum is economically unemployable. Further, the minimum wage becomes the standard wage, and the better men are inadequately paid. Both causes lead to decreased production. The better men, finding extra effort uncompensated, drop to an ever-decreasing minimum. Small output is in most cases the result of inadequate incentive rather than active restriction. Promotion by seniority is an example of a similar cause.

Among the professional and business classes the remuneration is proportional to the skill and to the effort. At the two extremes stand riches and starvation, and the economic world can offer no stronger motive forces than the allurements of the one, the fear of the other. There is no absolute reason why the working man should not be offered the same incentives to hard work and progress, but up to the present most efforts have tended in the opposite direction. Any form of payment by result is viewed with indifference or distrust by the unions, and past experience with piece work explains that attitude. There has been a disposition for employers to make large individual earnings an excuse for cutting rates. Errors in rate fixing may easily arise, and in certain cases special investigation might be necessary, but the advantages of high individual production are so great to both employer and employed that in all cases of doubt the higher rate should be maintained. In this connection the method of time-study first developed by Taylor in America and the various systems of payment by results which have been successfully applied deserve careful consideration.

Another important but difficult subject is the distinction drawn between skilled and unskilled labour. The experience gained during the war has proved that many operations scheduled as skilled work could be effectively performed by women who had only received a few weeks' special instruction. The oft-repeated demand for equal opportunity for all becomes a senseless parrot cry if it does not imply that an individual has the right to undertake better remunerated work if qualified to do so. It is a misconception which leads the skilled worker to believe that such a concession would reduce his earnings. Just as it is clear that if labourers and skilled men were grouped together at a uniform wage, that wage would necessarily be lower than the present minimum for skilled work, so also the separation of tasks which require but a nominal period of training would increase the rate of remuneration available for the really skilled man.

I have drawn attention to some of the difficulties which must be solved if the country is to emerge from the present crisis prosperous or even solvent. There is little doubt that an elucidation is possible, but it can only be evolved by the honest and intelligent collaboration of all parties concerned, a task rendered difficult or impossible by mutual distrust and class hatred. A satisfactory economic system can only be based on natural human impulses, and of these the most fundamental is self-preservation, or, more generally, self-interest. Increased production is at the present moment the most pressing national need, but it will become effective only when for every man increased production becomes the talisman by which his wages can be turned to gold.

Mathematical and Physical Science Section.

Presidential Address by

Prof. A. Gray, M.A., LL.D., F.R.S. (*Abstract.*)

As this is the first meeting of the British Association since the conclusion of peace I have decided to endeavour to point out some of the lessons which the war has, or ought to have, taught our country and those who direct its policy, and in particular ourselves, whose vocation it is to cultivate and to teach mathematical and physical science.

The part which physical science has played in the conduct of the war on our side has been an important one, but it has by no means been so decisive as it might and ought to have been. And here lie the lessons which I think we can draw from the terrible events which have taken place. Some few people, mostly hostile to or jealous of science, whose vision of facts and tendencies seems to me to be hopelessly obscured by prejudice, would try to impose on the advance of natural knowledge and the supposed increased influence of scientific ideas on the minds of men, or, perhaps more precisely, on the diminution of the study of the so-called humanities, the sole or the main responsibility for the outbreak of war. It seems to me that a good many people allow themselves to be misled by a name. The name *Humanity* is given in the Scottish Universities to the department of the Latin language and literature, and in a wider usage the study of Latin and Greek is referred to as that of *Litteræ Humaniores*. But I am not aware that there is any more humanity, in the common acceptation of the term, about these studies than there is in many others. And experience has shown that the assertion that these studies have a special refining influence, while the pursit of science has a brutalising tendency, is based on ignorance and partiality. The truth is that the man who nows nothing of science, and he who has neglected the study of letters, are both imperfectly educated.

The accusation may be dismissed without argument. This is certainly not the time nor the place for a discussion of the causes of the war, or of the ethics of the extraordinary methods introduced into warfare by our enemies. But one thing I will say in this connection. Even poison gas is innocent in itself, and it occurs as a product in perfectly indispensable and eminently useful chemical processes. The extraordinary potency of scientific knowledge for the good of civilised mankind is frequently conjoined with a potency for evil; but the responsibility for an inhuman use of it does not lie with the scientific investigator. The guilt lies at the door of the High Command, of the high and mighty persons, themselves in feeling and temper utterly unscientific, who approved and directed the employment of methods of attack which destroyed the wounded and helpless, and wrecked for ever the health of many of those who emerged alive from the inferno.

As a people we are incorrigibly forgetful and appear to be almost incapable of profiting from experience, which, according to the Latin proverb, teaches even fools. Nearly twenty years ago the urgent necessity for the reorganisation of our military machinery had been, in the view of civilians at least, who had to bear the cost of the war in South Africa, demonstrated *ad nauseam*, but nothing of real importance in the way of reforming the War Office seems to have been done, and the country drifted on towards its fate. All this time an enormously powerful war machine was being built up on the Continent, and its different parts tested so far as that could be done without actual warfare.

Now it is often alleged that men engrossed in the pursuit of science are unbusinesslike, but I think that, if there had been any truly scientific element in the *personnel* of the Government (there never is by any chance), attention would have been directed at a much earlier period to our hopeless state of unpreparedness for the storm which was gradually gathering up against us on the other side of the German Ocean. In discussions of our unpreparedness the emphasis has been placed on our lack of arms and munitions. But important as these are, the entire absence of a scientific organisation to guide us in the exigencies of a defensive war

with the most scientific and most military nation of Europe was even more serious.

It is this deficiency in our organisation, a deficiency the avoidance of which would have had no provocative effect whatever, which concerns us here very specially. It is, moreover, a deficiency which, in spite of the lessons they have received, has, I fear, not yet been brought home to our military chiefs. When war broke out nothing had been done to ensure the utilisation for special service in the multitude of scientific operations, which war as carried on by the German armies involved, of the great number of well-trained young scientific men available in the country. The one single idea of our mobilisers was to send men to the trenches to kill Germans, and for this simple duty all except certain munition workers and men in the public services were summoned to the Army. Some modifications were made afterwards, but I am speaking of the failure of prevision at the outset. The need of men for special service, the inevitable expansion of the Navy for patrol and other purposes and the like, were, if they were thought of at all, put aside, without regard to the difficulties which would inevitably arise if these matters were delayed. We worried through, but at a loss of life and treasure from which it will take us long to recover.

The Germans, I believe, had a complete record not only of all their men fitted only for the rank and file, but also of all who had been trained to observe and measure. For the use of even the very simplest apparatus of observation a certain expertness in reading graduated scales, and generally a certain amount of trained intelligence, is required, For this the laboratories of Germany amply provided, and the provision had its place in the enemy's mobilisation. Our people apparently did not even know that such a need existed or might arise. Very soon after the formation of the first Kitchener Army, it began to be seen that officers in sufficient numbers could not possibly be obtained by the usual channels, so the expedient (a poor one by itself) was hit upon of placing the nominations to commissions in one at least of the two great scientific corps of the Army—the Royal Engineers—in the hands of the presidents of certain technical institutions which have their headquarters in London. These gentlemen, with the help of the official secretaries, no doubt did the best they could, but a very regrettable, though perfectly natural, amount of strong feeling was evoked among the young scientifically educated men in the provinces, who were keenly anxious to join this corps. Over and over again young engineers came to me, and complained that under the arrangements made they had no chance of obtaining commissions, or of qualifying as cadets, and begged me to write to the authorities. Of course, young graduate engineers do not as a rule join societies such as the Institutions of Civil, Mechanical, or Electrical Engineers, until they have made their way to some little extent, and begun to earn a little money.

It may be said that full information regarding every man in the country was in the hands of the authorities. In a sense this was true; the information existed in millions of returns, and thousands of pigeon-holes, but no attempt was made, or could be made, by office staffs in London, enormous as these quickly became, to digest and utilise it.

A large number of engineers and physicists and many others of mechanical skill and aptitude found congenial occupation in the Royal Naval Air Service and the Royal Flying Corps; but even there, where things could be better done, since a new force had to be brought into existence, arrangements were to a considerable extent haphazard and ill thought out. Excellent self-sacrificing service was rendered by many, who risked and gave their lives, and of what was done we may well be proud. But from a scientific point of view there is room for great improvement. I wish all success to the League of Nations, but we shall prove ourselves even greater fools than we have been in the past if we do not use all possible means to prepare ourselves against eventualities.

The formation of a record of scientific graduates for special service ought not to be difficult. The material already in great measure exists. Each university and college has its roll of graduates or diploma holders, and with slightly more detailed entries these rolls would give the record. Each graduate of a university is kept track of through the necessity for keeping the electoral roll up to date, and it ought to be possible to devise a means of maintaining touch with the diploma holder. If each university or college were a local centre of the Central Committee, the making of the roll of graduates would be achieved at the different local headquarters, and would be a valuable supplement to the O.T.C. work now undertaken so willingly, and done so well. The Government machinery which manages the O.T.C. movement might control the keeping of the register which I have suggested.

I turn now to another side of scientific work during the war. It was my lot to serve for nearly three years on the Inventions Panel of the Ministry of Munitions, and as the result of that experience I venture to make some observations on the utilisation of scientific knowledge and genius in the production of inventions useful for the public service. The Ministry of Munitions Inventions Department was, so far as I could see, eminently well managed.

Many of the so-called inventions were not inventions at all. A favourite notion, which illustrates the diffusion of scientific knowledge among different classes of people, was that of taking a magnet—any magnet—up on an aeroplane, and using it to attract Zeppelins and other aircraft. Others suggested electro-magnets fed by machines which would have involved carrying into the air on an aeroplane a fully equipped power-house! Another favourite notion was that of rays charged in some way with electricity, or some other mysterious agency, and therefore intensely destructive.

But there was a residuum of valuable inventions, which fully justified the existence of the department. These were recommended for further consideration by the various departments of the services, or by General Headquarters. It by no means followed that all that came to this stage received careful further consideration. And it was by no means certain that when important approved appliances were sent to G.H.Q. a thoroughly well-informed and capable officer would in all cases have the duty of explaining and showing their action. The absence of such an officer, I am sure, often resulted in delay and serious error, and, I fear, also in the rejection of what was in itself exceedingly good, but was not understood. People who knew nothing about the matter took charge, and ordered things to be done which brought disaster to the apparatus. I know of one very important machine which was ruined, with much resulting delay. A Brigadier or Major-General with a confidence born of blank ignorance ordered a motor-generator to be put on town electric mains, and of course burnt it out.

Then, again, we were told that G.H.Q. did not want this or that, and here, as in all human affairs, mental inertia certainly played a considerable part. The willingness, however, of some departments to adopt at once a device captured from the enemy was pathetic. Often quite clumsy and relatively inferior contrivances were adopted in the midst of hesitation about our own. Anything German of this sort some people assumed must be good—a foolish idea, the result of want of confidence, often well founded, I am afraid, in their own judgment. It is legitimate to copy from the enemy, and in several important things we have not been slow to do so.

The delays that occurred were to some of us at home, who were anxiously dealing with all kinds of contrivances, exceedingly exasperating. Some were undoubtedly unavoidable, but others were far otherwise. Deficiency in scientific education was the cause. It is to enforce the need for such education that I refer to such matters at all. The "playing fields of Eton" are all very well. I for one do not scoff at what the old saying stands for, but scientific laboratories and good intelligent work in them are indispensable. A man who directs in whole or in part a great machine must know something of its structure and capabilities.

I feel bound to allude to another aspect of the inventions business which, to my mind, was very serious. In doing so, however, I wish it to be clearly understood that I am criticising a system and in no way here referring to particular individuals concerned in its administration. Various inventions which had passed satisfactorily the first examinations by responsbile judges were submitted to technical departments at home to be subjected to practical tests. These inventions were, frequently, solutions proposed of problems on which technical officers, of the departments required to conduct the tests, had long been engaged. It was natural, indeed inevitable, that some of these officers should have come to regard the solving of these problems as their own special job, and so did not much welcome the coming of the outside inventor. Then, no doubt, they often felt that they were just on the point of arriving at a solution—a feeling that certainly could not facilitate the avoidance of delay. It was manifestly most unfair to ask them to judge the work of the outside inventor, or to place in their hands details of his proposals, for exactly the same reason which in civil life restrains a man from acting as a juror in a case in which he is personally interested. Nobody of good sense feels offended when attention is called to such a rule in practice.

Thus I have no hesitation in expressing the opinion that a testing board of practical, well-qualified physicists and other experts, with a properly qualified staff, should be formed for the purpose of carrying out all tests of inventions. No insuperable difficulty would, I believe, be experienced in forming such a board. It should be formed carefully, not by more or less casual nomination of one another by a few persons. Expert knowledge of a subject should be a necessary qualification; the so-called "open mind" of the much-lauded but untrained practical man is not worth having. But on that board neither inside nor outside inventors of the same kind of appliances should have any place, though, of course, consultation with the author of an invention under test would be absolutely necessary. Also those actually carrying out the tests and those collating the results should not be men in any way in the employment of or under the supervision of inventors, whether "outside" or "inside." It is imperative in the interests of the country that delay in such matters should be avoided, and that all such work should be done without fear or favour.

The value of university and college men trained in science has been thoroughly proved in the artillery, the engineers, and in their offshoots, the Special Sound Ranging and Survey Corps, though its recognition by the authorities of Whitehall has been scanty and grudging. Some of the old-fashioned generals and staff officers could not be got to see the use of men who had not been trained to field exercises by a long course of drill. What is the good of officers, they said, who are not skilled leaders of men? This is the old crude idea again of destroying Germans with rifles, bayonets, and hand grenades. The falsity of these antiquated notions has now, I believe, been amply demonstrated.

The objection to these men, however, lies a good deal deeper. Even those scientifically educated officers who came into the new armies when they were formed, and were trained by the service of years of warfare superadded to the initial course of drill, have been demobilised in a nearly wholesale manner, without the least regard to even very exceptional qualifications. Many of these were, it seems to me, the very men who ought, above all, to have been retained in the service. Now (though, as I write, improved regulations are being issued) they are to a great extent to be replaced by the public school *sum* Sandhurst young gentlemen, who, it appears, are the "pucca" officers *par excellence*.

The old system of the rule of politician chiefs whose only or main function is to sign the edicts of heads of departments seems to have returned in full force, and the coming of the cleansing Hercules that many people desire for the War Office does not seem to be within the bounds of possibility.

The real cause of the prevailing neglect of science, with all its pernicious results, is that almost all our political leaders have received the most favoured and fashionable form of public school education, and are without any scientific education. An education in classics and dialectics, the education of a lawyer may be a good thing—for lawyers; though even that is doubtful. For the training of men who are to govern a State whose very existence depends on applications of science, and on the proper utilisation of available stores of energy, it is ludicrously unsuitable. We hear of the judicial frame of mind which lawyers bring to the discussion of matters of high policy, but in the majority of scientific cases it is the open mind of crass ignorance. The result is lamentable: I myself heard a very eminent counsel declare in a case of some importance, involving practical applications of science, that one of Newton's laws of motion was that "friction is the cause of oscillations"! And the helplessness of some eminent counsel and judges in patent cases is a byword.

As things are, eminence in science is no qualification, it would even seem to be a positive disqualification, for any share in the conduct of the affairs of this great industrial country. The scientific sides of public questions are ignored, nay, in many cases our rulers are unconscious of their existence.

I myself once heard it suggested by an eminent statesman that an electrical efficiency of 98 per cent. might by the progress of electrical science be increased fourfold! This, I am afraid, is more or less typical of the highly educated classical man's appreciation of the law of conservation of energy; and he is, save the mark, to be our minister or proconsul, and the conservator of our national resources. It is not surprising, therefore, that in connection with the nationalisation of our coal mines, there was not a single word, except perhaps a casual vague reference in the Report of the Chairman, to the question of the economic utilisation, in the interests of the country at large, of this great inheritance which Nature has bestowed upon us.

The fact is that until scientific education has gone forward far beyond the point it has yet reached, until it has become a living force in the world of politics and statesmanship, we shall hardly escape the ruin of our country. The business men will not save us; as has been said with much truth, the products of modern business methods are to a great extent slums and millionaires. It lies to a great extent with scientific men themselves to see that reform is forthcoming; and more power to the Guild of Science and to any other agency which can help to bring about this much-needed result.

While scientifically educated men, whether doing special work or acting as officers, have been held of far slighter account in the services than they ought to have been, for physicists as such there has been little or no recognition, except, I believe, when they happened to be ranked as research chemists! The various trades asserted themselves, and the result was a sufficiently long list of "reserved occupations," a list remarkable both for its inclusions and for its exclusions. But for a young scientific man, who was not in trade, there was no place.

Research chemists received their recognition in consequence of the existence of the Institute of Chemistry. I am extremely glad to find that something is now being done to found an Institute of Physics. I hope this movement will be successful, and that it will be thoroughly practical and efficient. I hope its President and Council, its members and its associates, will be jealous for science, and especially for physics. They have an example in the General Medical Council, which has so effectively cared for the interests of the medical profession.

I am glad that something is being done at last for the organisation of scientific research. This movement has started well in several, if not in all, respects, and I wish it all success. There are, however, one or two dangers to be avoided, and I am not sure that they are fully recognised, and that the result will not be too much of a bureaucracy. I am reminded by the papers I have seen of the remark of a poor man who, asking charity of someone in Glasgow, was referred to the Charity Organisation Society of that city. "No, thank you," he said; "there is a good deal more organisation than charity about that institution." So I hope that in the movement on foot the organisation will not be more prominent than the science, and the organisers than the scientific workers.

There is, to my mind, too much centralisation aimed at. Everything is to be done from London: a body sitting there is to decide the subjects of research and to allocate the grants. Apparently already existing local incentives to research work are to be transferred to London. I venture to protest against any such proceeding. The more incentives and endowments of research that exist and are administered in the provinces the better.

There is another danger to be avoided besides that of undue centralisation in London. In most of the statements I have seen regarding the promotion of research work the emphasis seems to be on industrial research, that is, in applied science. This kind of research includes the investigation of physical and chemical products of various kinds which may be used in arts and manufactures, and its deliberate organised promotion ought to be a commercial affair. I observed, by the way, with some amusement, that according to the proposals of one Committee for Applied Science, which is prepared to give grants and premiums for researches and results, the professor or head of a department, from whom will generally come what are most important, the ideas, is to have no payment. He is supposed to be so well paid by the institution he belongs to as to require no remuneration for his supervision of the committee's researches. And the results are to be the sole property of the committee!

There is in this delightfully calm proposal at least a suggestion of compulsion and of interference with institutions and their staffs, which ought to be well examined. Also some light is thrown on the ideas of such people as managing directors of limited liability companies, who are members of such a committee, as to what might reasonably be expected of men of high attainments and skill, whose emoluments taken all round are on the whole miserably insufficient.

I think that it is in danger of being forgotten that, after all, pure science is by far the most important thing. Most of the great applications of science have been the products of discoveries which were made without any notion of such an outcome. Witness the tremendous series of results in electricity of which the beginning was Faraday's and Henry's researches on induction of currents, and the conclusion was the work of Hertz on electric waves. From the first came the production and transmission of power by electricity, from the last the world has received the gift of wireless telegraphy. I am not at all sure whether the great men who worked in the sixty or seventy years which I have indicated would have always received grants for proposed researches, which to many of the good business directors and other supermen serving on a great bureau of investigation, had such then existed, would have appeared fantastic and visionary. In research, in pure science at least, control will inevitably defeat itself. The scientific discoverer hardly knows whither he is being led; by a path he knows not he comes to his own. He should be free as the wind. But I must not be misunderstood. Most certainly it is right to encourage research in applied science by all available and legitimate means. But beware of attempting to control or "capture" the laboratories of pure science in the universities and colleges of the country. Let there be also ample provision for the pursuit of science for its own sake; the return will in the future as in the past surpass all expectation.

The implications of dynamics are at present undergoing a very strict and searching examination, and now we may say that a step in advance has been taken from the Newtonian standpoint, and that a new and important development of dynamics has come into being. I refer, of course, to the new theories of relativity, which are now attracting so much attention.

The better the student of physics is grounded in the older dynamics, and especially in the dynamics of rotation, the sooner will he be able to place himself at the new point of view, and the sooner will his way of looking at things begin to become instructive.

I had just concluded this somewhat fragmentary address when the number of *Nature* for July 24th came to hand, containing a report of Sir Ernest Rutherford's lecture at the Royal Institution on June 6th. The general result of Sir Ernest's experiments on the collision of α-particles with atoms of small mass is, it seems to me, a discovery of great importance, whatever may be its final interpretation. The conclusion that "the long-range atoms arising from the collision of α-particles with nitrogen are not nitrogen atoms, but probably charged atoms of hydrogen or atoms of mass 2," is of the utmost possible interest. The α-particle (the helium atom, as Rutherford supposes it to be) is extraordinarily stable in its constitution, and probably consists of three helium nuclei each of mass 4, with two attached nuclei of hydrogen, or one attached nucleus of mass 2. The intensely violent convulsion of the nitrogen atom produced by the collision causes the attached nuclei, or nucleus, to part company with the helium nuclei, and the nitrogen is resolved into helium and hydrogen.

It seems that, in order that atoms may be broken down into some primordial constituents, it is only necessary to strike the more complex atom with the proper kind of hammer. Of course, we are already familiar with the fact that radio-active forces produce changes that are never produced by so-called *chemical* action; but we seem now to be beginning to get a clearer notion of the *rationale* of radio-action. It seems to me that it might be interesting to observe whether any, or what kind of, radiation is produced by the great tribulation of the disturbed atoms and continued during its dying away. If there is such radiation, determinations of wave lengths would be of much importance in many respects.

Long ago, when the cause of X-rays was a subject of speculation, and the doctrine that mainly found acceptance was that they were not light waves at all, I suggested to the late Prof. Viriamu Jones that radiation of extremely small wave length would be produced if atomic or molecular vibration, as dis-

tinguished from what in comparison might be called molar vibration, could be excited. An illustration that suggested itself was this: Take a vibrator composed of a series of small masses with spring connections. If these masses are of atomic or molecular dimensions any ordinary impulse or impact would leave them unaffected, while vibrations of groups of them, depending on the connections, would result. But the impact on one of the masses of a hammer of sufficiently small dimensions and mass would give vibrations depending on the structure of the mass struck, and independent of the connections, just as the bars of a xylophone ring, while the suspended series of bars, if it swings at all, does so without emitting any audible sound. This is, I believe, in accordance with the theory now held as to X-rays. We now have some information as to the mode of producing a local excitement so intense as to cause not merely atomic disturbance, but actual disruption of the atomic structure. Further developments of Sir Ernest Rutherford's experiments and of his theory of their explanation will be eagerly awaited.

THE TRAMWAY INDUSTRY.

Joint Industrial Council.

The first meeting of the Joint Industrial Council for the tramway industry was held at the Ministry of Labour, Whitehall, London, S.W., on Friday last. The following officers were appointed: Chairman, Mr. W. J. Squires (chairman, Highways Committee, London County Council); vice-chairman, Mr. Stanley Hirst (Amalgamated Association of Tramway and Vehicle Workers); joint secretaries (Employers'), Mr. J. Beckett, F.S.A.A., Municipal Tramways Association, Gothic House, Accrington; Mr. A. de Turckheim, Tramways and Light Railways Association, 33, Tothill Street, Westminster, S.W.1; (Employés'), Mr. J. Cliff, Amalgamated Association of Tramway and Vehicle Workers, 5, Leaf Square, Pendleton, Manchester. This is the forty-sixth Joint Industrial Council to be formed, and the fifth Council dealing with industries in which both municipal and company-owned undertakings are concerned.

Wages Dispute.

Some time ago the Transport Workers' Federation made application to the two associations representing publicly- and privately-owned tramways for a 12s. increase in wages, the merging of the war bonuses in permanent wages, and the reduction of the qualifying period for the payment of the maximum from seven years to six months. The employers stated that they were willing to discuss only the question of the qualifying period. On August 27th the matter was discussed at a joint meeting in London of the executives of the Tramways and Light Railways Association, the Municipal Tramways Association, and the Transport Workers' Federation. The latter suggested that the men's demands be referred to arbitration, and it was agreed that this proposal be submitted to national conferences of the municipalities and companies concerned, to be held separately in London. A promise was made to give the Federation a reply by September 4th. Conferences were held on that date at which the employers took the view that any advance in wages would involve still higher fares or subventions from rates, and they proposed arbitration under the Wages (Temporary Regulations) Act, insisting that the arbitration should be by districts. This, however, the men "flatly and irrevocably" opposed. Sir Robert Horne, Minister of Labour, met representatives of the Municipal Tramways Association, the Tramways and Light Railways Association, and the Transport Workers' Federation, at the Ministry of Labour on Friday last. It was agreed that the Minister of Labour should prefer the claim to the Interim Court of Arbitration under the Wages (Temporary Regulation) Act, the terms of reference to include a schedule of the undertakings which are affected by the national claim. It was found impossible to get the bodies to agree as to the arrangements for the hearing. The undertakings contended that the Court should hear the case in the districts. The Federation's representatives, on the other hand, declined to waive their point that the claim, being a national claim, must be dealt with on a national basis, as had been the case at certain previous arbitrations. In the end, the Minister intimated that the question of the arrangements for the hearing was a matter within the discretion of the Court of Arbitration. It was arranged that the case should be referred to the Court, and that the Court should be asked to grant a preliminary hearing to the parties at 10.30 a.m. on Monday, September 15th, at which hearing the parties would put forward their respective contentions as to the procedure to be adopted. At the preliminary hearing the Arbitration Court will be asked to make early arrangements for the further proceedings.

New Spanish Company.—La Sociedad Espanola de Construcciones Electricas is the name of a new concern which has lately been formed in Barcelona with a capital of £280,000 to take over and carry on the electrical engineering business of Messrs. J. Pich, in that city.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Proposed Amalgamation of the Engineering Trade Unions.

In view of the ballot on the amalgamation proposals for the engineering unions, it will no doubt be of interest to the various grades employed in electricity undertakings, who are cited on the Schedule of Award 2,772, to know what their position will be, under the new scheme, with particular reference to the existing working agreements between the Electrical Trades Union and the three other unions, parties to the award, and in order to obtain an official decision on the subject, the following questions have been submitted to Mr. James Rowan, general secretary of the Electrical Trades Union, whose replies are attached.

H. H. Morton,
Secretary, London Station Engineers, No. 1 Branch.
London, S.E.
September 6th, 1919.

Question.	Answer.
Will the projected scheme in any way impinge on the existing status and relations, as between the Electrical Trades Union and the three other unskilled unions parties to Awards Nos. 2,772 and 2,773?	No. On the other hand, the agreements will have the support of all the skilled trades in the amalgamation.
Will the projected scheme in any way prejudice the status of the negotiating committee of electrical railway engineers, and the four unions parties to Award 2,773?	No. The agreement will be made to cover all, and will have the support of all trades.
Will the projected scheme in any way prejudice the decision of the Blackpool Conference to accept for membership all grades employed in the "generation, transmission, distribution, and maintenance of electrical energy"?	No. The amalgamation proposals do not in any way vary the qualifications for admission at present in operation.
Will the projected scheme affect the exercise of autonomy by the Executive Council and District Councils of the Electrical Trades Union, in so far as the electrical industry is concerned?	Yes. When amalgamation takes place one Executive Council composed of representatives of all the unions will be the governing body, and each District Committee will be composed of representatives of all the trades; of course, sectional sub-committees can be appointed.
Will the projected scheme abrogate the new rules as drawn up by the Delegate Conference at Blackpool *other* than those dealing with finance?	Yes. It is proposed to set up a Rules Committee to draft one set of rules to replace the present rules of all the unions, but the principles embodied in the proposals before the members must be embodied.
It is stated that, "When the result of the ballot is declared a Conference of Executives will be convened to determine how the Rules Committee shall be appointed." As no doubt the Committee will be appointed by numerical strength, in consequence of which the station section of our union will possibly not get any direct Executive representation at all, is any provision made for representation from sections of industry, as apart from representation on an aggregate numerical strength only, other than that representation cited under section (*b*) Districts?	There is no intention of appointing the Rules Committee by numerical strength. It must of necessity be appointed by, and from, the amalgamating unions, and the representatives of these unions will be expected to deal with the special circumstances of the sectional interests of their own members.

The Co-ordination of Commerce.

In your courteous review of my booklet on "Reconstruction and Foreign Trade" you refer to the difficulty of starting a large organisation owing to the present position of Government finance. May I draw your attention to the fact that my proposed scheme is to be self-supporting, the revenue being derived from exporters paying, voluntarily, 5s. per £100 on the value of their exports, or ½ of one per cent. For this

they would receive all the advantages of the world-wide organisation proposed. The Government is only asked to make good any deficit there might be during the first 10 years. If the commercial and manufacturing firms of the country became members of the proposed Federation of Commerce in reasonable numbers there would be no deficit, while the advantage of the organisation to the trade of the country cannot easily be overestimated. The Government is simply to act as guarantor for a term of 10 years. If all the new efforts now under consideration were based on such sound financial proposals there would be much for the country to gain and little to lose.

In the last paragraph of the review you state "Mr. Williams's proposals are ambitious and we may be excused if our faith fails us when we consider them in the midst of our present troubles," &c. That was the attitude of the profession in April, 1916, when I had the honour to place my proposals for the reform of the electricity supply of Great Britain before the Institution of Electrical Engineers. I have a letter from one colleague fully agreeing with the proposals of the paper, but giving it as his opinion that though the scheme proposed, or something similar, must ultimately come, yet it would never be in our lifetime. Another letter from him, a short time ago, was to congratulate me on the second reading of the Electricity Bill, which so closely followed my original proposals. The co-ordination of commerce is a less difficult problem than reform in electricity supply, while the advantages to be gained are even greater. Unfortunately our leaders do not realise the urgent need for reconstruction in our methods of dealing with foreign trade as they realised the urgency of the electricity supply problem. The latter was before their eyes, while the former problem is a world-wide one, and usually only fully appreciated in its true proportion by those who have travelled extensively. However, I am happy to note that the Premier referred to this subject in his last speech, and if the commercial community would only get together and put something *concrete* before the Government no doubt it would be welcomed. The booklet I have written was to suggest some such concrete proposal, and I am not without hope that it may assist in increasing interest in and in helping towards the solution of the problem. There is little doubt, in my opinion, that at the root of most labour troubles, and particularly the policy of limited output, is fear of unemployment. Nor is this greatly to be wondered at when we remember the serious unemployment conditions of a few years ago. But labour will, I feel sure, soon learn that its true welfare lies in the direction of unlimited output, and when that time comes the enormous production of which this country will be capable will require an outlet vastly greater than anything yet in view. It therefore behoves our business men to see that the foundations for greatly extending our foreign markets are pushed on with all speed, otherwise a time may arrive when the output exceeds the demand and unemployment may again ensue. If this occurs the policy of unlimited production will receive a setback from which it will not recover for many years.

Ernest T. Williams.

London, N.W., *September 2nd*, 1919.

Two Views About Gas.

In a brief lunch interval to-day—between working on specifications for the electrical equipment of a large housing scheme and considering electric cooking decided upon by the committee of a prominent hospital which previously used gas—I looked at the current issue of *Punch* (September 3rd).

Your excellent contemporary has a world-wide reputation for impartiality and showing both sides of a question, but a little rearrangement in this issue, so that advertising page iv came opposite contents page 207, would have enhanced this reputation—even if it had resulted in a fight between the advertising and artistic staffs.

Page iv states the advantages *from the British Commercial Gas Association point of view* of gas fires.

Page 207 shows the disadvantages, from the *Punch* artistic staff point of view, of being blown out of your house and setting it on fire by using a gas stove.

The B.C.G.A. advertisement says two leading architects agree that £30 per small house can be saved by smaller flues if gas fires are adopted. What can be saved by abolishing flues altogether and using electric fires?

Of course, Sir, there's nothing like leather, &c., &c., but I think we score this time.

H. C. Crews.

Manchester, *September 3rd*, 1919.

The Compilation of Trade Publications.

The remarks of Mr. Laverick in your issue of August 13th are of a now well-known type. Everybody agrees with them and then forgets all about them.

We are constantly being reproved for our sins of commission and omission in the publicity sense, and our attention is gently but firmly drawn to the attractive methods of our friends across the herring pond, whose gifts of salesmanship are certainly of a very high order. We all agree.

Mr. Laverick, Mr. Lloyd George, Mr. Bottomley, and many others insist that we must improve our methods; we agree again. In fact to our own people we also insist on the necessity for improvement.

We decide to start at once, and look around for the best methods and assistance. We decide to study the methods of the experts and ask the representatives of publicity houses to call on us. We note their "sales talk," excluding from our consideration the representative of one firm who addressed our very dignified secretary as "Dear old Bean," and we then analyse their offers.

Invariably they amount to this:—

We are to map out the sales campaign, methods of handling, packing, shipping, &c. We are to write all the matter for catalogues, booklets, leaflets, &c.; we must prepare the matter for our advertisements, and the expert will then quote us for printing the catalogue in an attractive form, and will, for a consideration, so ornament and embellish our advertisements as to make them look pretty and pleasing to the eye.

The representatives were obviously men who had studied the art of salesmanship.

They (with the one exception mentioned above) knew exactly how to "approach the prospect," what to do with their hat, gloves and stick. They also very obviously "weighed one up" and endeavoured to adjust their conversation to one's level (I shudder when I think how the first man talked of racing, while the last sympathised with me on the present high price and scarcity of whiskey).

But when it came to the real practical side of engineering publicity they simply faded away. They were all excellent fellows, clean and well groomed, but we were reluctantly compelled to the conclusion that they could not fulfil our requirements, and we then decided to utilise the services of one of our own keen young engineers who may not be a "literary gent," but who at least knows the engineering side of the business, and can write simple direct English.

If Mr. Laverick can formulate any workable scheme of engineering publicity which will give real practical service, I think he is on a good thing, and I can promise him the support of my company for one; but I should recommend him to hurry up, or else most of us will have solved the difficulties in our own way, and our way may or may not be the right one.

I think I am right in saying that English manufacturers are anxious to have their publicity done in the best possible manner, but they want to be shown, not merely talked to.

F. N. Pickett,
Managing Director,
Picketts, Ltd.

Hove, *September 3rd*, 1919.

Boiler-house Practice.

Your leader on boiler-house practice will cause many readers to turn up their files and reread Mr. Parsons's communication.

As a race we are conservative, and station engineers are too often no exception to the rule. I find, when discussing the question of coal economy with my friends, that the suggestion to install coal weighers to enable exact results to be obtained is frequently turned down on the score of expense, coupled with the structural difficulties of installation.

If circumstances are such that coal weighers are impossible, much valuable information can be obtained by other methods of measurement which will give comparative figures for each shift's work. Mr. Parsons rightly insists on figures being available continuously for short definite periods, such as the 8-hour watch.

An ingenious and not sufficiently well known coal measuring device for use on moving-grate stokers is that devised by Mr. Walter Markby, chief engineer of the Metropolitan Electric Supply Co. By a simple adaptation of the Lea recording gear fairly accurate results of coal consumption can be readily obtained. The inventor and Mr. Lea, who is handling the patent, would be the last to suggest that the apparatus was as accurate on varying grades of coal as a good auto coal scale, but they claim to obtain figures well within commercial limits.

The Erith Riley Stoker and the Underfeed Grate can both be fitted with counters which will give a fair approximation to the fuel burnt, but on the latter grate, unless the engine stroke is fairly constant in travel, errors of considerable magnitude may arise. Last, but not least, on small installations the coal can often be weighed in transit from heap to firing floor, but how often is this done, even when the facilities are available?

One word of caution: Absolute reliance should never be placed on figures obtained by summation of automatic measuring apparatus records. The coal stock should be measured weekly and the consumption as recorded by measuring apparatus checked against the actual stock on hand. Many wonderful results have been obtained till the shortage on the stock coal pile was accidentally discovered! The measurement of water is usually a much simpler proposition; there is no excuse for the responsible engineer who does not install suitable measuring apparatus for ascertaining the quantity of water pumped into the boilers, but here again frequent tests under working conditions must be taken to ensure accurate results.

Last, but not of least importance, the electric meters on the generators are too often looked upon as infallible. How many central-station engineers have any facilities for testing the meters *in situ*?

Many otherwise well-equipped works are spoilt by the lack of recording instruments. Much valuable information can be

gleaned from a close study of continuous records of draughts, CO_2, steam and superheat. The circulating water should be recorded alongside of the vacuum, &c. However useful the data obtained may be, they are of much greater value if the results can be recorded in a form which is intelligible.

If the methods of interpreting results could be standardised it would be helpful, and if Mr. Parsons could give further suggestions I am sure they would be welcomed by many central-station engineers.

F. D. Napier.

London, S.W., *September 8th*, 1919.

My Home-coming.

I set out my experience to indicate what less experienced electrical engineers are up against in the hope that our profession may be induced to give preference to those who have served and are out of work.

I am one of those who built up the public electric supply to what it has become, having worked in all capacities as consultant, resident engineer and contractor for over 25 years.

I offered my services before conscription, and have been demobilised after over four years' active service.

As ex-borough electrical engineer to a large town since 1902 I applied with confidence for the following advertised posts: Southampton, South Shields, West Ham, Carlisle, Doncaster and even Torquay and Bradford (assistant), but in practically every case a non-service man in possession of a post was selected. I have also applied to the Board of Trade, other Government Departments, most electrical firms, and have advertised, all without success.

A hard blow came from the I.M.E.A.—or rather the committee—when I was refused an invitation to the annual congress. I was a member, and had entertained the Congress twice at much trouble and some expense.

For the last three months I have *given* my services to the Ex-Officers' Bureau at Dashwood House, a voluntary organisation which advertises to employers in your columns, and am daily dealing with as many tragedies as my own.

Last Legs.

[We refer to this matter in our leading columns to-day.—Eds. Elec. Rev.]

Air Supply for Pianola.

Referring to Mr. Spencer's inquiry *re* the above, I am afraid a centrifugal fan would not be suitable for the work, as the characteristics of these fans are such as make them only suitable for delivering or exhausting large volumes of air against small pressure or vacuum usually expressed in inches of water gauge.

I would suggest either driving the existing bellows by the motor or having small motor-driven bellows, three in number, on a three-throw crankshaft. With regard to the pressure or vacuum required, take the pressure required to compress the equaliser spring or springs, and divide this by the area of the equaliser, the result giving the pressure or vacuum in lb. per sq. in.

If Mr. Spencer cares to write to me direct, I shall be pleased to afford him any further information.

C. H. Nicholson, A.M.I.E.E.

11, Maple Grove, Hull,
September 8th, 1919.

Balancing and Alignment of the Alternator Rotor.

I beg to draw your attention to the article under the above heading, by Mr. C. Sylvester, A.M.I.E.E., in your issue of August 29th.

As most modern turbo-alternators never run at the critical speed, a badly balanced rotor would not be detected in the way indicated. In a special case where critical speed was reached I do not see why the whipping shaft should touch any particular spot on the end shields, which would be of guidance in adjusting the balance.

Fig. 1 shows two grooves at one end of the rotor with a balance weight in each. Why not put both weights in the same groove and simplify the calculation of the resultant?

In the case of high-speed sets it is desirable, and sometimes necessary, to carry out dynamic balancing, even though the static balance is unaltered during the process.

Vibration is not always due to defective balance.

There is an error in the article where the checking of alignment is described. If the gauge fitted perfectly on the journals after raising the alternator end pedestal alone, then the gauge must have been defective or the observations inaccurate. The disappearance of the end thrust, which was probably due to two errors in alignment, or to a defective coupling, does not necessarily indicate that the alignment was improved. On the contrary, in view of the fact that the bearings next the coupling ran at a higher temperature, one would be led to believe that it was worse than before.

I do not agree that a floating coupling can be such a fit that the shaft behaves as if it were solid throughout. However, as the coupling stiffens up on load, the adjacent journals should be dead in line.

W. H. M. Kelman.

London, S.W., *September 8th*, 1919.

Remuneration in British Commerce.

I think that all staff employés must feel deeply indebted to you for having taken up the cudgels on their behalf, and for pointing out that what is necessary as a simple act of justice to these men is also a necessary step in the direction of obtaining and maintaining the lead in the world's markets.

It is perfectly true that the whole scale of remuneration, both at home and abroad, needs wholesale and drastic revision.

But it is none the less true, as you hint in your leading article, that the general treatment of staff employés also needs revision. After 24 years' experience, many of them spent abroad, I can add my quota to the other testimony you have had as to the better treatment received from firms of Teutonic or American extraction. With them, the personal interest in an employé's welfare, comfort, and progress is constantly felt to be alive and real. In other words, the whole traditional policy of the firms I refer to is deliberately set to encourage the employé's feeling of self-respect and well-being, and this is so ingrained in the policy and so little at the whim of one or two men, that the effect is felt even where the employés run into the tens of thousands.

They are truly democratic, whereas so many "superior" British firms (and I hasten to add that the only non-British ancestor I can trace was a Huguenot) are too autocratic and feudalistic in their ideas. A further subject for your pen might well be the one-sided and grasping agreements which are so common in British staff employment.

To conclude, might I draw your attention to the advertisement on page 20 of this week's issue for an estimating engineer for India. I would ask the pertinent question as to when and how 700 Rs. per mensem became the equivalent of £700 per annum at home?

I regret that I am debarred from appending my name, but enclose my card, and remain,

Export.

September 5th, 1919.

Electric Vehicles.

The main points in Mr. Spalding's letter on the above subject appear to be: (1) It is not the duty of central-station engineers to act as salesmen, (2) electric vehicles are very difficult to sell, (3) manufacturers are so busy with orders in hand that they cannot promise delivery on any new order in less than eight months, and (4) I am narrow-minded and completely ignorant of the true facts.

If I had written an article urging central-station engineers to encourage the use of electric light and power I suppose I should have been told that it was not their business to push the sale of lamps and motors. It is a bright argument, and if I am narrow-minded, I wonder what Mr. Spalding imagines he ought to be called. I cannot find anything in the article which suggests that manufacturers should be relieved of their usual obligations. What I endeavoured to point out was that whilst some central-station engineers are taking a very keen interest in the movement, others appear to be more or less indifferent, and if Mr. Spalding considers that I am talking nonsense it would be interesting to know how he accounts for certain statements I referred to in the report of the Electric Vehicle Committee.

E. Austin.

London, W.C., *September 8th*, 1919.

The Welfare Movement.

During the last three years, inspired by the efforts of far-seeing firms, the welfare movement has made very rapid strides in this country, and the wide recognition now being given to it by employers, workers, and public men leaves little doubt but that within a few years it will occupy a very prominent position in the industrial world.

So far no real attempt has been made, either by State or voluntary agencies, to collate information regarding various phases of the work; in fact the names of firms interested in the movement are not even recorded in any place.

The Industrial Welfare Society is anxious, for the benefit of industry generally, to collect from the pioneers of this movement, information regarding their doings in connection with welfare work. I shall therefore be grateful if those firms who are willing to assist in this way will apply for particulars of the information desired to the Industrial Welfare Society, 33, Tothill Street, Westminster, S.W. 1.

Robert R. Hyde,
Director.

London, S.W.
September 9th, 1919.

Meter Readers' Books.

Mr. Turnbull's letter on the above subject in your current issue raises once again the old question of "books *versus* cards"; opinion on the subject is still greatly divided. After considerable experience with both systems, as applied to meter reading, I have come to the conclusion that a card system, carefully thought out and well organised, is the nearest approach to perfection that can be obtained.

A suitable card for the purpose is one about 5 in. long by 3 in. wide, printed on both sides and with spaces at the top for street, number, consumer's name, and meter number. The remaining portion of each side should be divided into six,

and these divisions sub-divided for date, inspector's initials, and meter and demand indicator readings if necessary. Thus 12 separate headings can be entered on one card.

When a new consumer is connected, the necessary particulars are filled in on a blank card and the initial meter-reading is entered. The card is then filed in a "street index" drawer until the reading period arrives. A small, neat leather case capable of holding 60 or 70 cards supplies the necessary means of transport, and can easily be carried by the meter reader in his pocket. If at any time between the periodical reading dates a special reading of any particular meter is required for any reason, such as a transfer of consumer, meter change, or the like, the card is obtained from the drawer and the reading entered direct by the person dealing with the matter. The system could be further extended by using cards of various colours for power, lighting, heating, and restricted or other supplies.

G. D. Malcolm.

Stepney Electricity Department,
September 8th, 1919.

Electricity and Kinematography.

I think Mr. G. E. Moore must have overlooked the small enclosed projection lamp which we make, and sell in large numbers, when he says, in the latter part of his interesting article, that in small projections, half-watt and other lamps are "ousting the small arc lamps." This is quite true so far as the ordinary open-type projection lamp, which requires constant attention, is concerned, but it is not true with regard to the small enclosed lamp mentioned above. This burns directly on 100 or 200 to 240-volt circuit with a current of 2½ or 4½ amperes, as arranged, and can be connected by an adapter to any ordinary lamp socket. The arc is struck by turning a milled knob, and will burn without adjustment for about half an hour. The positive carbon is horizontal, and the crater of the arc being exactly in the centre of the lens never gets out of focus. The adjustment, when necessary, is almost instantaneous.

I shall be very pleased to give full particulars to Mr. Moore or show him or any of your readers these lamps, if they are interested.

J. O. Girdlestone.

London, N.W.
September 8th, 1919.

BUSINESS NOTES.

Openings for British Trade.—Australia.—A company in Melbourne desires to represent British manufacturers of electrical plant, covering the whole of Australia (Department of Overseas Trade, ref. No. 555). A manufacturers' agent, whose representative is in England, desires to get into touch with U.K. manufacturers of electrically-driven machinery, dynamos, cables, &c. (Official Secretary, Commonwealth of Australia, Coml. Inform. Bureau, Australia House, London, W.C. 2, ref. No. 223/2/7).

Canada.—H.M. High Commissioner for Canada, 19, Victoria Street, S.W., reports the receipt of the following inquiry:—A Canadian firm of manufacturers' agents are prepared to undertake the exclusive representation, throughout the Dominion, of United Kingdom manufacturers of electrical goods of all descriptions.

Belgium.—A firm in Brussels desires to secure an agency for United Kingdom manufacturers of cranes, tramway materials of every description, mechanical transporters, &c. Very well recommended. (Reference No. 568.*)

Catalogues and Price Lists Wanted.—H.M. Representative at Prague reports that he has received many applications from different parts of Czecho-Slovakia for catalogues and price lists of the following goods:—Electrical apparatus, machine tools, and mining machinery.

British firms who are interested in these goods should send catalogues direct to the Chambers of Commerce in the important centres in Czecho-Slovakia, addressed as follows:—

Obchodin a Ziv-nostenska Komora (Chamber of Commerce), vyvozni Kancelar (Export Department) at Prague, Budweis, Olomouc, Brno, Opava, Eger, Reichenberg, Plzen, Bradic-Kralove, Bratislava, Kosice or Troppau, in Silesia.

These 12 towns comprise the chief trading centres in the Republic.

Brazil.—A partner of a firm of general commission agents in Pernambuco (a British subject), who has had several years' experience in Brazil, is at present in this country, and desires to obtain agencies on a commission basis for electrical fittings, &c. (Reference No. 585.*)

*Replies should be addressed to the Department of Overseas Trade, 73, Basinghall Street, E.C. 2.

Industrial Committees.—From the current issue of the *Electrical Contractor*, we learn that local Industrial Committees have been formed at Liverpool, Bradford, and Sheffield. A new working card of the E.T.U. is being discussed at various centres. Complaints are made in some districts of under-cutting in the sale of T.L.A. lamps, and the direct sale of these lamps to the public from manufacturers' stores.

Steel and Wood Poles Wanted.—Bacup Corporation electricity department is requiring several 30-ft. steel poles, also wood poles of same length (new or second-hand), for street-lighting purposes. For full particulars see our advertisement pages to-day.

"Anchor" Works Hospital and Distress Fund.—The annual report of the "Hospital and Distress Fund" of the Leigh Works of Callender's Cable and Construction Co., Ltd., states that grants amounting to £91 7s. have been made to local and Manchester hospitals, and £229 5s. 1d. has been paid in grants to necessitous members. To the "Special War Fund" the employés have contributed £936 10s. 1½d. In addition to sending out gifts of parcels and cigarette money to employés who were in the Army, £318 has been expended on Service men, and amongst other liberal allowances, £500 has been allocated for the purpose of assisting those men employed by the company at the time of joining the Forces, affected by disablement due to war service, while a further £150 has been transferred to the "Hospital and Distress Fund" to meet future cases which may come under this head. At the annual meeting, held recently, liberal contributions were voted to hospitals, &c., for the coming year. The chairman—Mr. J. Bowyer (works manager)—suitably referred to the loss they had sustained in the death of the president, Mr. James Callender. The meeting unanimously elected Mr. T. Petersen (Callender's Cable and Construction Co., Ltd., London) president for the ensuing year. The resignation of the hon. sec., Mr. R. Hocken, who has rendered yeoman service, was accepted with regret, and a hearty vote of thanks was accorded to him. Mr. W. Hulme Jones was unanimously elected as his successor.

The Government Scheme of Long-Term Credits for Export.—As foreshadowed in our last issue, the Government is now prepared through its Export Credits Department at 10, Basinghall Street, E.C. 2. to consider applications for advances up to 80 per cent. of the cost of the goods, plus freight and insurance, for goods sold to Finland, the Baltic Provinces (Latvia, Esthonia, and Lithuania), Poland, Czecho-Slovakia, Jugo-Slavia, and the areas in Russia to which the scheme for insurance against abnormal commercial risks applies—subject to the following conditions:—

1. Documents are to be surrendered to the buyers against their acceptance of a bill in sterling drawn by the sellers for the full amount of the invoices, together with security (see the next paragraph). The Government will release the drawers from any recourse against them for the amount of the advances made.

2. The purchasers must agree to take up such documents against a deposit of currency calculated on the basis of the market exchanges, such deposit to be made with an approved bank in the country of purchase, and to be held as security for the due payment of the bills.

3. When the advance is needed, the relative documents will have to be accompanied by a letter of guarantee from an approved bank of the country of purchase stating that the documents will be promptly taken up against such deposit of currency, and undertaking that the amount of such currency shall always be maintained at a figure sufficient to give a margin of 15 per cent. over the value of sterling as based upon the exchanges (not upon the official exchanges, if any). All applications accompanied by a banker's guarantee of sterling payment at maturity of the bill will receive preferential consideration.

4. The Department will consider proposals for a deposit of produce or securities instead of currency.

5. The advances made by the Department will be a first charge upon the proceeds of the bills and securities; but, if such proceeds are less than the cost, plus freight and insurance, the loss represented by the difference will be divided between the Department and the drawer of the bill in the proportion of the advance made to the cost (plus freight and insurance).

6. The credits are to outstand only for such periods as the Department may determine in each case at the time of application for the advances.

7. The Government will settle from time to time the countries and goods to which the scheme relates, but advances will not be made for the export of raw materials and preference will be given to the finance of goods where the larger part of the cost is due to manufacture in this country.

8. All applications must be passed to the Department by the bankers of the sellers, whose recommendation must be attached.

9. After satisfaction of the advance the bill and securities will be handed to the seller if payment of the full amount of the bill has not been made.

10. At any time after maturity of the bill or after any default, the department will be entitled to close a transaction and hand over the security held, the seller bearing his proportion, as indicated above, of any loss incurred.

11. The conditions set out above may be modified at any time or in special cases.

With the consent of Barclay's Bank, Ltd., Mr. L. A. Davis, deputy foreign manager of that bank, has been appointed manager of the Department.

Standardisation of Driving Chains.—From Messrs. Brampton Bros., Ltd., Birmingham, we have received a copy of the standards adopted by the Association of British Driving Chain Manufacturers, of Bassishaw House, Basinghall Street, London, E.C. 2. The other members of the Association are the Alfred Appleby Chain Co., Ltd., the "Coventry" Chain Co., Ltd., and Messrs. Hans Renold, Ltd. The standards relate to chains from ⅜ to ¾ in. pitch, of widths from 0·130 to 0·460 in.; the chains are made in two widths for each pitch. Particulars of the corresponding teeth are given. The new chains will be available early in December, and chains of larger pitch will be standardised later.

Joint Industrial Council for the Cable-Making Industry.—The first meeting of the Joint Industrial Council for the Electric Cable-Making Industry was held at the Ministry of Labour on Thursday, September 4th. Mr. Bertram Wilson, of the Ministry of Labour, who presided during the earlier part of the proceedings, pointed out that this was the forty-fifth Joint Industrial Council to be formed.

Mr. L. B. Atkinson, Cable Makers' Association, was elected chairman; and Mr. A. Allison, of the India-Rubber, Cable, and Asbestos Workers' Union, vice-chairman; and the following were appointed as joint secretaries:—

For the Employers' side ... Mr. H. Standring (Messrs. Frankenburg & Sons, Ltd.).
For the Employés' side ... Mr. H. McCale (Workers' Union).

New French Company.—La Société des Phares et Equipement Electriques (Phares Aertsens) is the name of a new company which has lately been formed in Paris, with a capital of £16,000, to manufacture electric lighting and engine-starting sets for motor vehicles.

Foreign Trade.—THE AUGUST FIGURES.—The following are the electrical and machinery figures given in the official returns of imports and exports for August:—

	August, 1919.	*Inc. or dec.*	*8 months*, 1919. *Inc. or dec.*
IMPORTS.	£	£	£
Electrical goods, &c. ...	72,410	+ 5,486	+ 140,282
Machinery	1,130,445	+ 206,345	+ 2,711,650
EXPORTS.			
Electrical goods ...	683,305	+ 497,274	+ 1,983,309
Machinery	3,235,962	+1,870,974	+ 7,386,477

Book Notices.—*British Standard Specification for Dimensions of Insulated Annealed Copper Conductors.* No. 7, 1919.—The British Engineering Standards Association's Report, No. 7 (Revised 1919), British Standard Specification for Dimensions of Insulated Annealed Copper Conductors for Electric Power and Light has recently been issued. The wire gauge as a means of designating the conductors has been dispensed with, and the number of sizes has been reduced considerably. A table giving the values of the resistance of a conductor 1,000 yards long and 1 sq. in. sectional area, at every degree between 40° F. and 120° F., and the constants to be employed in converting the resistance of a wire from any temperature between these limits to 60° F., has been included. In the tables at the end of the specification details of the conductors, the thicknesses of the dielectric lead sheathing, armouring, bedding, &c., and the values of the test pressures are stated.

The specification deals with circular wires from 0·0076 in. to 0·1030 in. diameter; solid and stranded conductors from 0·001 sq. in. to 1 sq. in., and with flexible conductors from 0·0006 sq. in. to 0·5 sq. in.

The thicknesses of the dielectric and lead sheathing, and the values of the test pressures, are given for the following classes of cable:—

Dielectric.	Working pressure, volts.
Paper	660, 2,200, 3,300, 5,500, 6,600, 11,000
Jute	660
Rubber ...	250, 660, 2,200, 3,300, 5,500, 6,600, 11,000

The price of this Report is 1s. 2d., post free; and copies may be obtained from the offices of the Association, 28, Victoria Street, Westminster, S.W. 1.

The Decimal Educator. Vol. II, No. 5. September, 1919. London: The Association. Price 6d. net.—With this issue commences the second year of the existence of this now well-known journal. There is some suggestion that a more attractive title might be adopted.

"Manual of the Electro-Chemical Treatment of Seeds." By C. Mercier, M.D., F.R.C.P., &c. Pp. xii + 134. 14 illustrations. London: University of London Press, Ltd., published by Hodder and Stoughton. Price 3s. 6d. net.

Irish Builder and Engineer. Diamond Jubilee Special Number in commemoration of 60 years of existence. Dublin: 54, Sackville Street. Price 6d.—The number contains a series of reviews by various well-known writers, treating of the progress during the past 60 years in the several subjects on which the journal specialises; amongst the contributors are the following:—"A Note on Roads," by Dr. P. C. Cowan, Chief Engineering Inspector L.G.B.; "Progress in Fighting Fire during 50 Years," by Captain T. P. Purcell; "Cheap Power for Industrial Development," by Mr. G. Marshall Harris, manager of the Dublin United Tramways Co., Ltd.; "Irish Industrial Reconstruction and the Utilisation of the Irish Bogs," by Mr. T. Tomlinson; "The Mineral Resources of Ireland," by Prof. H. J. Seymour.

Railway Goods Rates.—It is stated that the question of economy on the railways will be given the greatest possible attention in the immediate future, Sir Eric Geddes, the Minister of Transport, having evolved definite plans towards this end, probably involving a substantial increase in goods rates. Mr. R. H. Hill, Sir Eric Geddes's secretary, recently said that it was highly probable that the goods rates would be increased considerably with a view to effecting the abolition of the coastal subsidy. It was not probable that an increase in passenger rates would occur. —*The Times.*

Non-Ferrous Metal Industry Act.—A list of further additions to licences granted under this Act was published in the *Board of Trade Journal* for September 4th.

Trade with Belgium.—The catalogue and sample room at the British Vice-Consulate at Liége has now been open for six months; we are informed by Mr. Joseph Pyke that the response of British firms for catalogues and samples of small bulk has hardly fulfilled expectations, but it is hoped that an important increase in the number received will be assured as the facilities which this organisation provides for bringing British products to the notice of Belgian buyers are realised. Catalogues for Belgium should be in French, if possible, with metric measurements, &c. The number of firms who have sent publicity matter up to date is slightly in excess of 300. "Thanks to the far-seeing and patriotic support of the editors of the leading trade journals, of which no fewer than 25 are furnished gratuitously, the normal equipment of this section is rendered much more important than would otherwise be the case, and the journals are studied by a large number of prospective customers for British goods."

During the past 123 days the number of visitors has aggregated 735; 330 prospective buyers of British goods and 463 applicants for British agencies have also been dealt with by correspondence. Banking and commercial references have been obtained from firms capable of furnishing them, and reports as to their standing have been furnished to the Department of Overseas Trade, to which British manufacturers and merchants are advised to apply for these particulars, while the Belgian firms are instructed to address their requests direct to the British houses whose names are furnished them.

The organisation described above being largely in the nature of an experiment, the continuance and development of which must depend upon the results attained, it is urgently requested that all firms who succeed in doing business by means of the publicity offered them should notify the fact to the British Vice-Consul, Liége.

Lead Market Report.—Messrs. James Forster & Co. report that closing prices last week showed an advance of 10s. per ton in all positions, due to the growing difficulty in obtaining supplies from Government stores and the intimation that no more sales of lead by the authorities would be made till the congestion at the wharves and stores was cleared up.

Messrs. S. Cawson & Co. say that there have fortunately been some arrivals of Australian lead, which have relieved the situation for the time being. Practically nothing is coming from Spain or America, and shipments from Australia are likely to be considerably curtailed owing to strikes.

Closing quotations are:—Prompt and September, £25 2s. 6d. to £25 5s.; October, £25 7s. 6d. to £25 10s.; November, £25 15s.; December, £25 17s. 6d., with buyers over at top prices.

Trade Announcement.—Mr. Wm. S. Park has retired from the firm of Menzies & Park, electrical engineers, of 208, Quarry Street, Hamilton, and the business will be continued by MR. JOHN MENZIES.

Catalogues and Lists.—REMCO CARBON CO., LTD., Canal, Gravesend.—Price list of Remco resistances, of which large quantities were used in war time, especially in connection with wireless telegraphy. They are suitable also for motor starters, regulators, dimmers, &c.

MESSRS. MOSSAY & CO., LTD., 7, Princes Street, London, S.W. 1. —Catalogues of Orwell electric platform trucks, types B and C; the former has three wheels, the latter four. Trucks with power-elevating platforms, and locomotives, are also described.

Overseas Trade.—Last week the Report of the Committee appointed to examine the question of Government machinery for dealing with trade and commerce was issued. The Committee makes the following recommendations:—

ABROAD.

1. That the Consular Service remain under the control of the Foreign Office (subject to Nos. 6 and 9, below).

2. That the proposals of the Scheme for the Reform and Development of the Consular and Diplomatic Service, other than those which relate to the Trade Commissioner Service and Labour Attachés, be adopted.

3. That the Board of Trade be authorised from time to time, after consultation with the Foreign Office, to send temporary missions for special purposes to foreign countries, such missions to be under the control of the Embassy or Legation concerned, and that for this purpose a sum be included yearly in the Board of Trade estimates.

4. That the Board of Trade be represented on the Selection and Promotion Committees for the Consular and Commercial Diplomatic Service.

5. That British representatives abroad should be recommended to keep in touch with the British Chambers of Commerce formed in the countries to which they are accredited.

AT HOME.

6. That the Department of Overseas Trade continue, as at present, under the joint control of the Foreign Office and the Board of Trade.

7. That the Board of Trade remain responsible for general commercial policy, and that it be the duty of the Department of Overseas Trade to give effect to that policy overseas.

8. That suitable office accommodation be forthwith provided for the Department of Overseas Trade in close proximity with the offices of the Foreign Office and the Board of Trade, and, if possible, that the three Departments be housed in the same building.

9. That the Consular and Commercial Departments of the Foreign Office be transferred to the Department of Overseas Trade.

10. That the War Trade Intelligence Department be transferred to the Department of Overseas Trade except as to those branches which may be more conveniently transferred to the Board of Trade.

11. That a Standing Committee or Board be formed for the discussion of matters relating to overseas trade, to consist of the heads of the Board of Trade, Foreign Office, and Department of Overseas Trade, with power to call in representatives of other Departments, and that such Standing Committee or Board meet at regular and frequent intervals.

In a Minority Report, Mr. Dudley Docker says that he considers that the system of dual control of the Department of Overseas Trade is at the root of the trouble. Any such system of dual control must be eradicated. He has come to the conclusion that the only remedy that he can recommend is the adoption of the principle that the Foreign Office must be responsible for establishing the lines upon which our foreign commercial policy should be framed.

Department of Overseas Trade.—The Board of Trade announces that the statement which has appeared in the Press as to the control of the Department of Overseas Trade is unauthorised and incorrect. The Department remains under the joint control of the Foreign Office and the Board of Trade, and any arrangements made as regards housing will not affect this joint control.

British Overseas Bank.—The bank will open to the public for general business on Monday next, September 15th.

Import Restrictions.—According to the *Bulletin* of the Federation of British Industries, a meeting of the Reconstruction Committee of the Federation was summoned for September 11th to consider the position, with special reference to the question of the removal of restrictions on imports.

Liquidations and Dissolutions.—Electricity Meters Patent Development Syndicate, Ltd.—Winding-up voluntarily, with Mr. T. S. Jones, 54, New Broad Street, London, E.C., as liquidator. Meeting of creditors, September 15th, at 54, New Broad Street, E.C. Claims by October 7th.

County Light, Ltd.—Winding-up voluntarily. Liquidator Mr. B. E. Mayhew. September 22nd, at Alderman's House, E.C. Claims by October 12th.

Bankruptcy Proceedings.—Benjamin Owen Ledbury, insulating engineer, Imperial Chambers, Caer Street, Swansea.—The adjourned public examination of this debtor was held, on August 29th, at the Town Hall, Swansea. The debtor stated that whilst in the employ of Mr. Perkins he never received a fixed salary, and Mr. Perkins owed him £40 for wages and work done. The examination and the application of Mr. Harold Williams, who appeared for the debtor, was adjourned, it being stated by Mr. Williams that certain questions of account in a partnership had yet to be gone into.

C. Mayfield, electrical engineer, Bristol.—Trustee (Mr. T. Easton, O.R.) released August 29th.

Coal Output Diminishing.—A Board of Trade return issued last week gives ominous indications of the grave outlook in connection with the supply of coal. Since May last there has been a serious diminution in the weekly output in all districts, due partly to strikes, partly to the shortened hours and other causes.

Auction Sale of Timber.—By order of the B. of T. and the Controller of Timber Disposal, Messrs. E. Challoner & Co., A. Dobell & Co., and Farnworth & Jardine will sell by auction at Liverpool, on September 25th, a quantity of imported hardwood timber, &c. See our advertisement pages to-day.

Outing.—On Saturday last the employés of Messrs. E. P. Allam & Co. resumed their annual outing; a perfect day was spent, commencing with the journey by train to Witham and by brake to Mill Beach (Heybridge). A river trip in Mr. Handley's yacht was really delightful. Dinner was served at the Mill Beach Hotel, the works manager, Mr. Wilfrid Hackett, presiding; tea was taken at the Spread Eagle Hotel, Witham, followed by a smokng concert, with Mr. Allam in the chair. Votes of thanks were unanimously accorded to Messrs. H. White and W. Atkinson, the stewards, for the way in which the arrangements had been carried out, and a vote of thanks to the chairman brought to a close a really happy day.

LIGHTING AND POWER NOTES.

Atherstone.—Prov. Order.—The proposal of the Midland E.L. & P. Co., Leamington, to apply for a prov. order for the supply of electricity to certain areas in Warwickshire, including the Atherstone district, was discussed by the D.C. last week. The vice-chairman of the Council intimated the intention of opposing the application unless the company gave an undertaking to supply electricity to the district within two years. A director of the company explained the scheme, saying that the application was being made with the concurrence of the Leicestershire and Warwickshire E.P. Co. The order obtained by the old company in 1902 only enabled it to supply electricity for power purposes, and the present order would extend the power so far as lighting was concerned. The supply would be available before the order was through.

Athy (County Kildare).—E.L. Scheme.—Arrangements have been made to appoint, early in October, an electrical engineer to plan out a scheme for electrically lighting the town, and to supervise the scheme whilst being carried out.

Beauly (Inverness-shire).—New Plant.—On August 29th a new generating set was started at the works of the E.L. Co., and will act as a stand-by to that installed in 1912. The company is extending the supply to new sawmills.

Blackburn.—Price Increase.—Charges for electricity for all purposes have been increased to a total of 75 per cent. above pre-war rates, as from the quarter ending December.

Bolton.—Street Lighting.—Electricity for street lighting is to be taken from the mains of the Corporation electricity department.

Bradford.—Electric Police Lamps.—The Bradford police have had a number of electric lamps issued to them in lieu of the oil lamps used when on night duty.

Burton-on-Trent.—Price Increase.—The T.C. has adopted the following revised tariff:—Lighting, flat rate of 8d., maximum demand rate temporarily withdrawn; outside shop lighting, 8d.; picture palaces, 6d., plus 15 per cent.; heating and cooking, 1½d.; power, such as for restricted supplies, 4d., down to 1½d., plus 15 per cent.; restricted hour supplies, 2d. to 1·3d., plus 15 per cent.; maximum demand system, 6d. for the first 1½ hours, and 2d., plus 15 per cent.

Camborne.—Price Increase.—The Urban E.S. Co. has applied to the B. of T. for an order to increase the price of electricity to 9d. per unit.

Chobham.—The P.C. has approached the Woking E.S. Co. with respect to a supply of electricity for the parish.

Continental.—France.—By an agreement come to between the Chemins Departmentaux de la Haute Vienne and the Conseil Général of the Department, the latter has agreed to advance 4,000,000 fr. to improve the equipment of the company's network—namely, the intallation of a supplementary turbine at the Eymoutiers station; the doubling of the 30,000-volt transmission line; the substitution of armoured cement posts for the existing wooden posts; and the purchase of special tractors to assure the goods service.

An important transmission scheme is about to be launched which will cost, it is said, several tens of millions of francs, and require three years for its completion. The object is to harness waterfalls in the Jura and the Alps, and transmit the energy generated to the Creusot works and to the industries located in the valley of the Dheune, Saone-et-Loire Department. One transformer station, situated at Montchanin, will distribute lighting and power throughout the entire Department.

Italy.—The water powers of Mount Gleno, in the valley of the Scalve, are to be tapped for two large hydro-electric stations of 14,000-H.P. total capacity, to be employed for industrial purposes, and initially for the working of the cotton mills of the firm of Galeazzo Vigano, at Ponte Albiate, and to supply blast furnaces in the Dezzo Valley. It is expected to be able to complete one of these stations by the spring of next year, and the other in 1921.

Germany.—A new scheme for supplying public buildings of Berlin with heat, and also with warm water, was adopted in Berlin in July last, says *Engineering*. The warm water is to be derived from the exhaust steam of the turbo-dynamos of the Berlin electricity works and from some coke-heated boilers, and is to enter the pipes superheated at a temperature of 120° C.; the pipes are to be laid in concrete conduits along the streets, the pipe sections to be welded together and to be provided with stuffing boxes and with sliding bearings. The distribution area is to have a radius of 2·5 km., and to include some tenement houses. The contract has been given to the firm of Körting A.G., and it was hoped to start supply by next winter.

Spain.—Application has recently been made for a concession to establish plant to utilise the water-power of the River Guejar, near Sierro, Granada. It is also proposed to establish plant to utilise the water power of the River Navia, near Oviedo, to generate electricity. It is stated that in this case over 25,000 H.P. will be available.

Denmark.—The scheme for the erection of a large hydro-electric works at Tange, which has been in suspense owing to difficulties arising from the war, is now to be proceeded with, and a company has been formed for this purpose under the title of the Gudenaa Central Station Co. It is expected that the works will be able to supply the whole of central Jutland between Djursland and Salling.

Crewe.—Price Increase.—The price of electricity is to be increased by a further 20 per cent., as from October 1st.

Derry.—E.L. Failure.—An immediate and big rainfall is needed to save a serious situation; the water reservoirs are now empty. The electricity works closed down on Tuesday, last week, for want of water, and manufacturing concerns and shipyards depending on electricity stopped work. An attempt is being made to supply sufficient power to keep the bakeries going.

A special meeting of the Corporation was held to consider a domestic supply. The city engineer said that if the strictest economy was observed, and the water used solely for domestic purposes, a famine might be averted. The electricity works has since resumed the supply.

Dewsbury.—Street Lighting.—Street lighting was resumed on Monday. This decision by the T.C. was reached as a result of street accidents which have occurred on dark nights.

Dover.—PRICE INCREASE.—The T.C. is to apply to the B. of T. for an order to increase the charges for electricity from 7d. to 9d. per unit, on the ground that it would be unfair to the public to do so whilst the Admiralty insists on holding the Council to the pre-war contract of 2·78d. per unit, which results in a heavy loss.

Doncaster.—E.L. FAILURE.—On September 3rd the electricity supply failed in the early afternoon for nearly an hour and a-half, for some reason which has not been made public.

Dundalk.—LOAN.—The Bank of Ireland authorities have intimated to the U.C. their consent to a loan of £3,000 at Bank of England rate, with a minimum 4½ per cent. during the pleasure of the Bank, for the purpose of carrying out improvements in connection with the electric lighting system, the advance to be collaterally secured by a charge on the rates and revenues of the Council, and to be repaid by equal annual instalments of £200, together with interest.

Dundee.—WATER POWER.—A report was issued on Friday last by Mr. Harry Richardson, Corporation electrical engineer, on the question of extending the city's electrical supply by the utilisation of water from the Tummel Valley. Mr. Richardson estimates the cost of the Loch Tummel scheme at £1,250,000, and states that electricity could be supplied at from 1d. to 1·08d. per unit, compared with 1·28d. per unit under the coal-driven generating station. The water-power scheme was well within the realms of practical use now, and they in Dundee were bound to consider it immediately and rapidly in the interests of industrial prosperity. The scheme involved the building of a dam at the eastern end of Loch Tummel, raising the water level, and carrying the water to a power house situated on the River Tummel below where the River Garry enters the River Tummel, into which river the whole of the water used would be returned. The scheme could easily supply any demands for power *en route* without prejudicing the interests of Dundee.

Eccles.—PRICE INCREASE.—The T.C. has advanced the price of electricity by a further 25 per cent., making a total war increase of 100 per cent.

EXTENSIONS.—A sub-station is to be erected at Monton at a cost of £540.

Finchley.—FIRE.—A fire broke out at the Finchley U.D.C. electricity works on Saturday evening, 6th inst., at 9.45 p.m. The outbreak was caused by the exhaust-pipe from an oil engine becoming red hot and igniting some oil in the trench beneath the engine. The brigade was called, and the fire was extinguished by 10.20 p.m., having caused no material damage; the town supply was maintained.

Haswell.—STREET LIGHTING.—The P.C. has sealed an agreement with the South Hetton Coal Co. for street lighting by electricity with 59 lamps at £4 each, from September 1st to April 30th.

Keighley.—PRICE INCREASE.—It is recommended that an increase in charges for lighting be made of 1d. per unit, and for power, to consumers who have no sealed agreement, by ½d. per unit, as and from October 1st next.

Leicester.—NEW PLANT.—A contract has been recently awarded to the English Electric Co. for new plant for the Aylestone power station, including a 5,000-KW., 3,000 R.P.M. turbo-alternator set, complete with condensing plant and circulating water piping, &c.; also rotary converters, transformers, E.H.T. switchgear, and a complete boiler-house equipment, including, for the initial installation, two marine-type Babcock water-tube boilers, each with a capacity of 50,000 lb. of steam per hour at 200 lb. pressure, superheated 250°.

Maidstone.—PRICE INCREASE.—Charges for electricity for lighting have been increased by ½d. per unit, and for power by ¼d.

Montrose.—HARBOUR LIGHTING.—The Harbour Board has received a communication from the North of Scotland E.L. Co. in regard to a proposed new agreement for the electric lighting round the dock and wharves. The Harbour Convener said it would be desirable to retain control of the lighting in the hands of the dock officials, while the proposal of the company was that a large part of it should be lit in the same way as the streets. He thought it would be advisable to consider the lighting of the lighthouses by electricity. If the Northern Lights Commissioners allowed it, there would certainly be a saving of man power, as the lighthouses could be lit from the dock.

Motherwell.—PRICE INCREASE.—The charges for electric light have been increased from 4½d to 5d. per unit, and ½d. per unit has been added to the charges for power and heating.

Newton Abbot.—PRICE INCREASE.—The Electric Supply Co. is applying to the B. of T. for an order to increase charges for electricity to 10d., but the company is prepared to enter into an agreement with the Council not to charge more than 9d. per unit.

Nottingham.—INCREASED PRICES.—A new tariff, to take effect from the meter readings for the June quarter, 1919, embodies the following alterations:—Lighting, a flat rate of 6½d. per unit; maximum demand: (*a*) for any quantity not exceeding the equivalent of 200 hours' consumption per half-year at the maximum power demanded by the consumer, at the rate of 8d. per unit; (*b*) any quantity exceeding the equivalent of 200 hours' supply per half-year, at such maximum power, 3d. per unit. In this connection the method of charging adopted by the consumer is to remain in force for at least two years.

Portadown.—PEAT FUEL.—In the weaving factory of Mr. Hamilton Robb, a peat gas plant for driving the machinery was installed in 1911, and has worked successfully since. The amount of peat needed to develop the 280 H.P. required for the factory is about 1,000 tons per annum, so that in the past eight years 6,000 tons of coal have been saved and a local industry assisted. A larger experiment is about to be taken in hand—this time a power station of 1,500 H.P., where electricity will be generated for local use. The approximate amount of peat fuel required is 6,000 tons per annum, or a saving of 4,500 tons of coal per annum.

River Clyde.—DOCKS ELECTRIFICATION.—The pumps at the Clyde Trustees' graving docks on the river are to be converted from steam to electric power. It is estimated that the capital expenditure will be £17,360, and the total annual saving about £3,700, including considerable reduction in labour employed at the docks. Other electrical work comprises the electrification of machinery at Princes Dock and the completion of three 8-ton cranes at Rothesay Dock, the total outlay, including expenditure on graving docks, being £60,000.

Royston (Yorks.).—E.L. SCHEME.—The U.D.C. is to approach the Yorkshire E.P. Co. with a view to a supply of electricity.

S. Africa.—CALEDON (CAPE PROVINCE).—The ratepayers have adopted the proposal for a £16,000 loan for an electric lighting scheme for the township. Prof. Bohle, of the Cape Town University, has been instructed to prepare the scheme and call for tenders.

Spennymoor.—PUBLIC LIGHTING.—The B. of T. is not prepared to accede to the request of the Northern Counties' E.S. Co. for an order for the discontinuance of the supply of electricity to the public lamps in the district.

Stockton.—HOUSING SCHEME.—With reference to the Corporation's housing scheme, it was reported that the Ministry of Health suggests that houses erected in the area of electricity supply should be served with electric lighting, and that it would be the duty of the Corporation to extend its mains for this purpose. No part of the cost of these mains, however, has to be charged against the housing scheme.

PRICE INCREASE.—A further advance of 5 per cent. in the charge for electricity has been made.

Surbiton.—PRICE INCREASE.—Callender's Cable and Contruction Co. has applied to the B. of T. for an order to alter the charge of 13s. 4d. up to 20 units per quarter, and 8d. beyond, to 9d.

Swansea.—YEAR'S WORKING.—After meeting all commitments, including redemption of debt, there will be practically £5,000 to the good on the year's trading.

COAL CONSUMPTION.—The official report of the B. of T. relating to 114 stations in the country showed that Swansea was second in the whole country, and the first in Wales and the West of England. The consumption per unit was 2·64 lb., and the only place that was better showed 2·61 lb. per unit.

Tuam (Co. Galway).—PUBLIC LIGHTING.—The tender of the E.L. Co. has been accepted for lighting the town for six months, at £110, which was £28 less than the tender for lighting by gas.

Todmorden.—PRICE INCREASE.—The T.C. has applied for power to increase the maximum charges for electricity by 50 per cent.

Walsall.—LOANS APPLICATION.—The T.C. has decided to make application to the Ministry of Health for sanction to the borrowing of £11,970 in respect of the erection of the new power station at Birchills, and also to the borrowing of £44,000 in connection with the electric supply undertaking.

Wigan.—LOAN.—The T.C. has approved a proposal to borrow £42,650 for the purpose of installing a 5,000-KW. generator. The T.C. is already in negotiation for a supply of about 2,800 KW., and the 5,000 set would hardly cover the demand.

Winchester.—YEAR'S WORKING.—The report on the working of the Corporation electricity department for the year ended March 31st, 1919, shows a revenue of £18,094 (£16,559); working expenses, £11,838 (£10,535); gross profit, £6,255 (£6,024). Out of this the following charges have to be met:—Interest on loans, £3,417 (£3,474); redemption of loans, £1,597 (£1,540); leaving a surplus (profit) of £625 (£445). Units sold show an increase of 106,917 units (10·7 per cent.) made up of:—Power, an increase of 167,091, or 45·0 per cent.; public lighting, an increase of 8,694; lighting, a decrease of 34,627, or 8·3 per cent.; heating and cooking, a decrease of 34,241, or 13·9 per cent. Six new consumers were connected during the year, these, with extensions to existing installations, represent an addition of:—Lighting, 12 KW.; power, 179 KW.; heating and cooking, 83 KW. It has been possible to show a reduction of over 0·37 lb. of coal per unit sold, the result of being able to make good use of the turbo-generator and of the bulk supply to the Air Ministry improving the station load factor by giving a better load during the night. The alterations to Nos. 1 and 2 hand-fired boilers to covert them into a modern unit complete with superheater and mechanical stoker were satisfactorily

completed, and the boiler will go into commission this summer. There have been no further extensions to the cable network. The extensions to the power station for giving a bulk supply to the Air Ministry were completed on behalf of that Department in June, 1918, and commercial supply was started at the beginning of September, the consumption during the winter months approximating 5,000 units per week. There is a prospect of making further use of this A.C. plant, as the War Office has entered into negotiations with the Air Ministry to take a H.T. supply for the camps at Morn Hill, Winnall Down, and Avington Park.

York.—Water Power.—The Electricity and Tramways Committee asks for sanction to purchase the weir and mill on the River Derwent for the purposes of an additional generating station, at the agreed cost of £1,700.

TRAMWAY AND RAILWAY NOTES.

Accrington.—Wages.—The Tramways Committee is to resist an application for a further increase of 12s. per week in tramway workers' wages. The demand was estimated to place an additional 5d. per week on every house rented at 6s. 6d. The workers are now receiving 140 per cent. above pre-war wages.

Bradford.—Goods Traffic.—Consideration was given, last week, to the scheme for the utilisation of the tramway system as a means of alleviating the congestion of the railways and transport services, and it has been decided to apply to Parliament for powers to carry heavy goods. Under the present regulations a maximum weight of 56 lb. is fixed for carriage by the tramways. If the powers asked for are granted, it will not mean the opening up of an inter-city system, but an extension of the present parcels delivery system.

Burnley.—Fire.—A tramcar caught fire, last week, owing to a cable fuse under the car.

Canada.—Strike.—The electrical workers of the Toronto tramway undertaking went on strike suddenly on the afternoon of September 3rd, and all tramwry cars in the city were stranded at the rush hour. The passengers, thinking the power had been cut off temporarily, remained in the cars until the news of the strike spread.

Egypt.—Strike.—The tramways dispute was settled at midnight on September 1st—2nd, the strikers having agreed to resume work on the conditions laid down by the Conciliation Board. The tramway company refused to yield to political agitation under the guise of so-called labour unrest. The service was to start on September 3rd.

After agreeing to resume work, the strikers at the eleventh hour, September 2nd, went back on their decision, putting forward a number of new demands and insisting upon the immediate satisfaction of all their claims. The Government Conciliation Board is to deal with the new dispute.

Leeds.—New Track.—The Corporation proposes to test the utility of a fenced track on sleepers for an express tramway service. Land on the Roundhay Road is to be acquired, and as the situation is well out of the congested area of the city, little difficulty is likely to be met in connection with road widening. The scheme will be extended to other areas if the proposal proves successful.

London.—Traffic Committee.—Sir Eric Geddes, Minister of Transport, is sending a letter to the chairmen of the County Councils of London and adjoining counties, asking for the appointment of a nominee on a special Advisory Committee he is setting up to deal with the traffic question so far as the powers of the Ministry permit. This Committee is being set up without prejudice to the idea advanced by the Kennedy-Jones Committee, now being considered by the Cabinet, that there should be for London a separate traffic authority to deal with the whole question.

Accidents.—A tramway accident occurred at six o'clock on Friday evening last week, in South London. The electric plough of a car was wrenched out of position at the points dividing the Brixton and Clapham systems at Kennington Gate, and became wedged across the conduit, and it was not until heavy sledge-hammers were brought into play that the plough itself could be smashed up and removed. In the meantime all south-going traffic was stopped on both routes. To relieve the congestion tramcars were turned at Kennington Gate for the various South London termini.

A train on the District Underground Railway became derailed at Westminster at 9.30 a.m. on Friday morning, last week, while travelling on the up-line. Both lines were blocked, and traffic was interfered with throughout the day. Immediately after the accident all trains came to a standstill, and some time elapsed before passengers were allowed to leave. The train involved was at the time entering the tunnel at Westminster Station, and the derailment was due to the breaking of an axle. A breakdown gang was promptly on the spot, but owing to the position of the damaged car in the bend of the tunnel, considerable difficulty was met with, and, instead of a crane, short jacks had to be used. During the day traffic was running Westward from St. James's Park, and Eastward from Charing Cross Stations only. Later in the evening Eastward traffic started from Aldgate East only. About 7.15 p.m. official intimation was given that the line had been cleared.

Manchester.—Strike Threat.—A stoppage of work is threatened by municipal labourers, which will involve electricity and tramways departments. The extremist section of the tramway workers are in favour of handing in notices at once.

Motherwell.—Proposed Sale.—With reference to the proposed purchase of the tramway undertaking by the T.C., the company has replied that it is prepared to sell at £463,000, equivalent to £13 10s. per £10 share, with compensation (£12,000) to directors and officials for loss of office. The negotiations are to be continued.

South Africa.—Cape Town.—After being out on strike for about three-and-a-half weeks, the employés of the Tramway Co. accepted the offer of the company, and the service was resumed on August 13th.

Port Elizabeth.—The tramway employés' strike has been settled on the same terms as were arranged in Cape Town, and the cars have recommenced running.

St. Annes.—Purchase.—An immediate reply is to be pressed for from Lytham Council in reference to the purchase of the Blackpool and Lytham Tramway Co. St. Annes has offered £140,000 for the undertaking, but as half the line is in the Lytham area, it cannot purchase without Lytham's consent or co-operation. Lytham Council has placed the matter in the hands of experts for report.

Sunderland.—Through Running.—Through-running with the District tramways, a private company, is to be adopted, subject to an agreement approved by the Council being entered into with the company.

Wages.—Ticket inspectors are to receive 5s. a week more than the senior motormen.

TELEGRAPH AND TELEPHONE NOTES.

Aircraft Wireless.—Pending the issue of licences by the Postmaster-General, temporary provisional authority for the use of wireless telephone and telegraph apparatus in aircraft can be obtained, in approved cases, by application to the Secretary of the Post Office.

Barbados.—It is reported that the Western Telegraph Co., of London, intends establishing its own direct lines between Barbados and New York, and to points on the South American coast, Percambuno, and Rio de Janeiro. There is also a scheme to establish a British cable from Barbados to St. Kitts, and thence to Halifax (N.S.).

Cable Breakdown.—It is reported that one of the telegraph cables between Newcastle and Gothenburg is not working. It is thought the breakdown may be due to an explosion.

Deferred Telegraphic Service.—Arrangements have been made for the resumption of the deferred service of telegrams between the United Kingdom and Canada. The messages will be forwarded over the British Imperial cable, and the service commenced on Wednesday. Telegrams intended for this service must be marked "*via* Imperial." A deferred service is also again in operation "*via* Imperial" to Australasia and the British West Indies.

Denmark.—The General Post Office gave notice, on September 6th, that a wireless service supplementary to the cable service is now in operation between the United Kingdom and Denmark for the transmission of ordinary and Press telegrams. The rates for ordinary telegrams will be the same as for telegrams sent by cable—*i.e.*, 2½d. a word; but Press messages will be transmitted by wireless at the reduced rate of 1d. a word. All telegrams intended for transmission by this service must be marked "*via* wireless."

France.—An inquiry has been made by the *Matin* at the telegraphic department of the French Post Office about telegrams sent from France to England that have been for some time now, dispatched by mail. The reply was: "We are taking all necessary measures to obviate partial temporary interruption of Anglo-French telegraphic communications. The dispatch of telegrams by post may have been rather frequent of late, but in a short time we shall be in a position to ensure the normal and regular transmission of telegrams to England."

Holland.—It is stated that a Committee has been formed in Holland to protect the interests of Dutch holders of shares and obligations in the German-Netherlands Telegraph Co., whose cables—Yap-Shanghai, Yap-Guam, and Yap-Menado—have been surrendered to the Allies under the terms of the Peace Treaty.

Proposed New Cable.—His Majesty's Commercial Secretary at Yokohama reports that the establishment of a Japan-American cable company is under contemplation, with the object of laying a cable between Yokohama and San Francisco. The title of the proposed company is the Nichibei Kaitei Densen Kabushiki Kaisha (the Japan-America Cable Co., Ltd.). The project appears to have met with a favourable reception by the Governments of Japan and the United States.

Sable Island.—A Halifax (N.S.) message reports that the wireless station at Camperdown is unable to get into communication with the Sable Island station, which, it is feared, has been destroyed by fire.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Atherton.—September 18th. U.D.C. One boiler plate cubicle. (August 29th.)

September 30th. U.D.C. Two 30-K.V.A., single-phase, 2,400/240-v. oil-cooled transformers. (See this issue.)

Australia.—SYDNEY.—November 10th. City Council. Supply of electric motors. Particulars from Electric Lighting Department, Town Hall, Sydney.

October 13th. City Council. Three 2,000-K.V.A., 33,000/5,000-volt, transformers. Electric Lighting Department, Town Hall, Sydney.

December 19th.—Metropolitan Board of Water Supply & Sewerage. Centrifugal pumps, electric motors, &c., for the low-level pumping station, Marrickville. Offices of the Board, 341, Pitt Street, Sydney.*

Adelaide Municipal Tramways Trust has decided to invite tenders for a new set of 10,000 H.P.

Bradford.—October 9th. Electricity Department. Two 1,500-KW. rotary converters, transformers, &c.; induced draught plant and chimneys, and three economisers. (See this issue.)

Grimsby.—September 25th. Electricity Department. Two 1,000-KW. converters and D.C. and A.C. L.T. switchgear; E.H.T. switchgear and cubicles; coal and ash-handling plant; 30-ton electrically-driven travelling crane. (August 22nd.)

India.—LAHORE.—Electric Supply Co. Generating plant, two 1,000-KW. and two 500-KW., three-phase, 6,600-volt turbo-alternators, &c.; boilers, mechanical stokers, &c.; sub-station plant, H.T. and L.T. mains, &c. (Specifications available October 1st.) (September 5th.)

London.—WESTMINSTER.—September 17th. B. of G. Electric lamps, fittings, &c. Mr. W. J. Lickley, Clerk to the Guardians, Princes Row, Buckingham Palace Road, S.W. 1.

Manchester.—September 23rd. Electricity Department. Two 250-K.V.A., three-phase, static transformers; two 500-K.V.A. ditto. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester.

South Africa.—WORCESTER (CAPE PROVINCE).—Tenders are being invited in connection with the extension of the power station and the installation of additional plant. The specifications have been prepared by Prof. Bohle.

Spain.—The Municipal Authorities of Jativa have recently invited tenders for the concession for the electric lighting of the town during a period of five years. Tenders have also lately been called for the concession for the electric lighting of the town of Villarrobedo, during a period of four years.

Warrington.—September 17th. B. of G. Electrical goods at the Whitecross Institution or Cottage Homes, Padgate. Mr. A. Bottomley, Clerk to B. of G., Bewsey Chambers, Warrington.

West Ham.—September 23rd. Electricity Department. One 1,000-KW. turbo-alternator, one 10,000-KW. surface condensing plant, two water-tube boilers, superheaters and stokers. (See this issue.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence), London.

CLOSED.

Bolton.—Tramways Committee:—

Eight bogie-car electric equipments and four spare motors.—English Electric Co.

Canada.—MONTREAL.—Harbour Commissioners. Equipment for the electrification of the Harbour:—

Generator set, switchboard, lighting transformers, &c., for the sub-station, including a 1,500-H.P. synchronous motor, direct coupled to two 1,200-v. generators.—Canadian General Electric Co.
Overhead apparatus.—Northern Electric Co.; Ohio Brass Co.; and the Canadian General Electric Co.
Control wires.—Standard Underground Cable Co. of Canada.
Feeder control wire.—Canada Wire & Cable Co.
Steel stranded wires.—Steel Co. of Canada.

The work of construction was to have commenced on September 1st. —*Electrical News.*

Newcastle.—The City Council, on September 3rd, agreed that a memorandum should be endorsed on a contract, dated February 27th, 1915, between Messrs. Walter Scott, Ltd. and the Corporation, for the supply of tramway rails and fishplates, substituting for the original contract price of £9,362 10s., the sum of £21,488 15s., the excess being due to the increase of prices during the war.

Sunderland.—Electricity Committee:—

Creosoted wood capping.—Armstrong, Addison & Co.
House service meters.—Ferranti, Ltd.
Turbine oil.—Prices Co., Ltd.

FORTHCOMING EVENTS.

British Association for the Advancement of Science.—Annual convention At Bournemouth. Friday, September 12th, and Saturday, September 13th

Birmingham and District Electric Club.—Saturday, September 13th. At the Grand Hotel, Birmingham. At 7 p.m. Paper on "High-efficiency Projector Arcs," by Mr. H. F. Steventon.

Salford Technical and Engineering Association.—Saturday, September 13th. At the Royal Technical Institute. At 7 p.m. Lecture on "The Electric Battery Vehicle and its Application," by Mr. G. F. Duckett.

Electricity Supply Commercial Association.—Wednesday, September 17th. Meeting of London Divisional Council. At Anderton's Hotel. At 6.30 p.m.

Municipal Tramways Association.—September 17th to 19th. At the Town Hall, Dundee. Annual conference.

Iron and Steel Institute.—Thursday, September 18th, and Friday, September 19th. At the Institution of Civil Engineers, Great George Street, S.W. 1. At 10 a.m. Autumn meeting.

Junior Institution of Engineers.—Saturday, September 20th. Visit to the National Physical Laboratory, Teddington. Meet at Teddington Station (L. & S.W. Railway), 2·45 p.m.

NOTES.

Reunion Dinner of Signal Company, R.N.D.—There was formed at Oxney Bottom an Association, to meet once a year and dine, to celebrate members' service with the Colours. This has now been extended to include all members of the Signal Company, R.N.D., *who were at Oxney Bottom*. Tickets will be half a guinea, and will be forwarded on receipt of remittance. Application should be made at once to the Hon. Secretary, Sigs., R.N.D., 9, Finchley Road, London, N.W. 8.

Electric Enamelling Ovens.—The increasing use of electrically-heated enamelling ovens has resulted in a demand for ovens of better construction and with better insulation than was in general use with the cheaper gas fuel. Some of the ovens which have been developed for electric operation have been tested by the Westinghouse E. & M. Co., with the following results:—

Type of oven.	Method of handling material.	Output in lb. of work per KW.-hour.
Kiln	Hand	6 to 8
Kiln	Truck	10 to 12
Conveyor	Semi-continuous conveyor	10 to 12
Conveyor	Continuous conveyor	25 to 30

In all types the oven insulation is placed between an inner and outer metal lining; through metal connections from the interior to the exterior of the oven should be reduced to a minimum. Tests indicate that 1 sq. in. (6·45 sq. cm.) of metal extending from the interior to the exterior surface of the oven will conduct as much heat to the atmosphere as about 7 sq. ft. (6,503 sq. cm.) of the high-grade insulation. It has also been found desirable to insulate the floor of the ovens in view of the desirability of obtaining uniform temperature throughout.—*Elec. World.*

Institution and Lecture Notes.—Municipal Tramways Association.—On Wednesday next the Annual Conference of the Association will be opened at Dundee; headquarters will be at the Royal Hotel, and the meetings will be held in the Town Hall. The president this year is Mr. T. B. Goodyer, general manager of the Croydon Corporation Tramways, and it is anticipated that a very successful meeting will take place.

We are unable to give any particulars of the programme, for the very good reason that the negotiations in which the Tramway Associations have been engaged with the Transport Workers' Federation have monopolised the time and activities of the officials; but we have no doubt that the meeting will be fruitful of good results, and that Dundee will see to it that the occasion—deferred from 1917, when Mr. Peter Fisher was president—is a memorable one in the Association's records.

Birmingham Electric Club.—The club opens its winter session to-morrow, with a paper by Mr. H. F. Steventon on "High Efficiency Projector Arcs."

The club was established in 1905 "to facilitate the exchange of information and ideas in electrical engineering," and incidentally to provide a social link between men engaged in the profession and business. There are now about 100 members. Its meetings are invariably successful, and anyone engaged in electrical work who happens to be in Birmingham on Saturday evenings will be sure of a welcome, and may possibly acquire some useful information. The meetings are held fortnightly at the Grand Hotel, at 7 o'clock.

On October 11th there is a paper on "Thermo-Electric Generators," by Mr. E. M. Walter.

On November 8th the paper is by Mr. T. Pettigrew, of London, on "Automatic Telephones," on which occasion a working equipment will be shown.

Iron and Steel Institute.—The autumn meeting will be held in London, next week, on September 18th and 19th. Fuel economy in iron and steel works will occupy a prominent position in the proceedings.

Electrical Power Engineers' Association.—A general meeting of the Derby and District Section will be held next Friday, Sept. 19th, at 7.30 p.m., at the Albert Hotel, Market Place, Nottingham. Members of other Sections and non-members of the Association connected with the electrical industry are cordially invited to attend. The meeting will be addressed by the Honorary Secretary of the Midland Division.

Inquiries.—Makers of "Plus mica" (soluble mica) are asked for.

King's College War Memorial.—A final appeal is being made by the War Memorial Committee of King's College, London (Hon. Treasurer, Mr. S. T. Shovelton, M.A., Secretary of King's College): An eminently suitable athletic ground has been found, and must be purchased before the end of September; a further £4,000 is still required for this purpose, as well as £6,000 for fencing, laying out the ground, and building a pavilion. All old students and friends of the College are urgently invited to contribute to the fund.

A Code of Signals for Traffic Regulation.—The Commissioner of Police of the Metropolis informs us that a Committee appointed by him has been sitting to consider the powers and duties of the police in relation to the regulation of traffic in the streets on other than special occasions, and in its report the Committee lays special stress on the necessity for signals to be codified and issued as instructions to drivers.

The code of signals suggested is as follows :—

FOR MOTORS.

(All signals to be given on the right-hand side of the car, and in ample time to be of use.)

Right forearm vertical	Stop.
Right arm horizontal	Turning to right.
Right arm horizontal and then swept to the left	Turning to left.
Right arm horizontal, palm of hand down, and moved slowly up and down ...	Slow down.
Right arm waved low from rear to the front	Pass.

FOR HORSE DRIVERS.

Whip rotated above head	Turning.
Whip raised vertically	Stop.

It is obvious that one code only is possible, owing to the confusion that would arise were duplicate signals admissible.

Fatalities.—Michael Bryne (21), a beater's assistant, employed in a paper mill at Maryhill, Glasgow, was killed one evening last week in the course of his employment. The foreman also received a slight shock, and it was then discovered that the workshop was "alive." Current was at once switched off, and all work stopped for the night.

James Bennions, labourer at the Cerebos Salt Works, whilst waiting near a window of the pan room, it was said at the inquest last week, put his hands on the electric lighting wires above the window. Hearing him shout his father ran to the window, and deceased dropped into his arms. Another man, who had tried to release him, was knocked down by receiving an electric shock. The jury found that Bennions was killed by catching hold of the electric wire and causing a leakage.

At the L.C.C. generating station, East Greenwich, Seymour Dickinson came into contact with a live coil while working, and was so severely injured that he died before reaching hospital. It was stated at the inquest that deceased had no business to be at the place where he was found without a second man accompanying him, but witnesses said he went because he was anxious to get on with his work. Deceased's arms, legs, and clothing were burned, and it was stated that he had received a shock at 3,800 volts. In recording a verdict of "Accidental Death," the Coroner commended Joseph Crane, who pulled Dickinson off the coil at great risk to himself.

Educational.—THE POLYTECHNIC, Regent Street, London, W. 1.—The new session commences on September 29th, and heads of departments will be in attendance each evening from the 22nd for the purpose of advising intending students in the selection of courses. Mr. W. Hibbert, M.I.E.E., is head of the Department of "Electricity, Electrical Engineering, and Physics."

SOUTH-WESTERN POLYTECHNIC INSTITUTE, Manresa Road, London, S.W. 3.—The new session commences on September 22nd. Both day and evening classes are provided. Dr. Lownds is head of the Physics Department.

LONDON COUNTY COUNCIL, HACKNEY INSTITUTE.—The next session commences September 22nd. Evening lectures and laboratory courses are held in Electrical Engineering subjects, including Electrical Measurements, Dynamos and Motors.

NORTHAMPTON POLYTECHNIC INSTITUTE.—The evening technical courses in all branches of mechanical and electrical engineering will commence on Monday, September 22nd, and the full-time sessional day courses in engineering and technical optics on September 29th. See our advertisement pages to-day.

The Amalgamation of Engineering Trade Unions.—At a mass meeting of 4,000 engineers at Glasgow, on September 7th, the scheme for uniting the 14 Trade Unions in the engineering industry was fully explained, and the proposed terms of amalgamation were discussed and favourably received by the meeting. The object is to bind together in one Union 500,000 workers with funds approximating £3,500,000.—*Daily Telegraph.*

Decimal Coinage.—A news agency circulated a statement, which was given in *The Times* of August 27th, to the effect that the report arrived at by the Royal Commission on decimal coinage was of a non-committal character, and that no legislation was likely to be recommended. *The Times* has been informed by Lord Emmott that this statement was not only unauthorised but also incorrect. The Royal Commission has not even begun to consider its report, nor have the commissioners exchanged any ideas on the matter.

The State and Disabled Soldiers.—The *Birmingham Post* says that a Royal Proclamation is to be issued respecting the employment of partially disabled soldiers; it is not improbable that the Proclamation will call upon every employer to employ in future, at Trade Union wages, not less than 5 per cent. of men who have sustained some disability on Active Service. Representatives of labour urge that these men were disabled in the service of their country, and the State should shoulder the burden.

The A.S.E. and Disabled Men.—According to the *Daily Herald*, the Government scheme for training disabled soldiers in the engineering trade is opposed by the Birmingham No. 12 branch of the Amalgamated Society of Engineers, which has considered the matter at a special meeting.

The first objection of the branch is that at the end of the three years' training the men would be placed in an unfair position in the labour market. They would be regarded by the Government and the employers as fully trained, but could not be so recognised by the Union, and therefore would not have the Union's protection.

Further, the branch holds that the disabled soldier is entitled to be trained in the most remunerative occupations possible, "not to a calling that will allow him to receive only a bare existence, even if successfully trained in so short a period."

A third objection is that it is unfair to introduce more men into the trade while approximately 5,000 members of the A.S.E. are out of work and thousands more are in the Army awaiting release. Moreover, the pre-war unemployment in the organisation averaged 4 per cent.

Ministry of Transport.—An order to be submitted to the King in Council, proposes September 23rd as the date from which certain powers and duties of the B. of T. will be transferred to the Minister of Transport (Sir Eric Geddes).

Appointments Vacant.—Boiler house superintendent (£250 to £300), for the Derby Corporation Electricity Department; meter superintendent, for the Dundee Corporation Electricity Department; meter tester and repairer, for the Hull Corporation Electricity Department; wiring superintendent (80s. rising to 90s. + 20 per cent. + £90), for the L.C.C. Tramways Department; charge engineer (79s. 6d.), for the Stockton-on-Tees Corporation Electricity Works; instructors of telegraphy and telephony, for the East Ham Technical College; mains assistant and station assistant, for the Sale U.D.C. Electricity Department. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW posted as to their movements.

Central Station and Tramway Officials.—Mr. S. M. HALLETT, station superintendent at the Newport Electricity Station, was presented with a smoking cabinet by the employés of the Isle of Wight Electric Light and Power Co. on resigning his position.

Torquay Corporation has appointed Mr. G. B. DENT, of Northampton, charge engineer at the electricity works at a salary of £220 per annum, and has increased the salary of the present charge engineer (Mr. J. L. MEDWAY) to the same amount.

Capt. HENRY KERNICK, M.C., of Cardiff, who was recently selected, out of a large number of applicants, to be manager of the Singapore Electric Tramways Co., left for Singapore last week.

Mr. J. BECKETT, for many years borough treasurer at Accrington, has commenced his duties as secretary of the Municipal Tramways Association of Great Britain. Last week his services at Accrington were recognised by the presentation, by the Corporation officials, of an English gold lever watch and gold albert. The Town Clerk and the Borough Engineer spoke in appreciation of Mr. Beckett's services over a period of 34 years, and the Chief Constable handed over the gifts. Mr. Beckett, in acknowledging the presentation, said the best feeling had invariably prevailed between his brother officials and himself.

Mr. T. N. MARTIN, A.M.I.E.E., of Newcastle West, has been appointed engineer of the new electric lighting undertaking of the Nenagh Gas Company.

Mr. BILLINGTON, general manager of the Wigan Corporation tramways, has resigned. The Tramways Committee, in expressing the hope that his health will be improved, proposes to allow him six months' salary in lieu of notice.

Mr. ROBERT M'FEDRIS, assistant engineer at the Ayr Corporation tramway depôt, has been presented by the employés on his marriage with a marble timepiece.

Prof. DOBSON, D.S.O., general manager of the Gas, Electric Supply and Tramways Departments of the Johannesburg Municipality, has resigned, the reason given being that of inadequate remuneration.

Mr. G. STUPORT, assistant electrical engineer to the Aldershot U.D.C., has obtained a Government appointment in West Africa.

Mr. P. J. TODD, who has been on the staff of the Yorkshire Electric Power Co. during the past nine and a half years, has resigned his position as charge engineer, and has been appointed boilerhouse superintendent to the Bradford Dyers' Association, Ltd.

Mr. E. BALMFORD, who for over four years past was in the service of the Yorkshire Electric Power Co. as assistant to the superintendent of the station construction department, has joined the staff of Messrs. Thorp and Atkinson, consulting engineers, of Leeds.

Mr. RAYMOND GOUGH, at present engaged by the Yorkshire Electric Power Co. as overhead transmission engineer, has resigned his position, and is taking up an appointment as assistant engineer to Mr. T. E. Alger, A.M.I.E.E., of the firm of R. Alger & Sons, electrical engineers, Newport, Mon.

Wolverhampton T.C. has voted an honorarium of 300 guineas to the electrical engineer, Mr. S. T. ALLEN, and increased his salary by £200. The Labour members of the Council strongly opposed the increase. Mr. Thompson (chairman of the Electrical Committee) said Mr. Allen's advance had been put off for four years. Undertakings not so large as Wolverhampton were paying their electrical engineer £1,000 per year, and in that respect it should be remembered that £1,000 per year now was not so good as £600 per year before the war. Alderman S. Craddock said that Wolverhampton was the second largest town in the country so far as the quantity of electricity generated was concerned, while their generating station was the seventh largest in England. Such a tremendous advancement had been made in the generation and supply of electricity in Wolverhampton during the past four years that the proposed increase was thoroughly warranted.—*Birmingham Post.*

General.—It is officially announced that Mr. H. G. BURGESS has been appointed principal representative of the Ministry of Transport in Ireland.

Mr. SEAN (JOHN) MCGHEE, M.P., a member of the Sinn Fein Party, who has begun practice in Belfast as a consulting engineer, was for some time on the staff of the Belfast electricity department, and afterwards acted as chief assistant electrical engineer under the Dundalk Urban Council.

Messrs. BRINDLEY & ELBOURNE announce that they have now taken possession of their offices at 110, Victoria Street, S.W.1, where they will practice as consulting engineers. Their principal activity will be to report and advise on factory reorganisation, with particular reference to production efficiency and co-ordination with labour. The partners are H. S. B. Brindley and E. T. Elbourne.

The following officers of the London Electrical Engineers have been confirmed in their rank:—N. Tegetmeier, G. Hurford, F. A. Hill, A.M.I.E.E.; A. Storer, H. C. Gibbs. In the same corps Second Lieutenants N. Tegetmeier, E. T. Tacagni, G. Hurford, F. A. Hill, A. Storer and H. C. Gibbs have been promoted to the rank of lieutenant after the qualifying service. The undermentioned second lieutenants have been promoted to the rank of lieutenant in the Electric Lights Companies with which they are serving:—A. S. Gosling, Cinque Ports Fortress Engineers; J. A. Graham, City of Dundee Fortress Engineers; A. O. Lyons, City of Dundee Fortress Engineers; A. Sedden, Lancashire Fortress Engineers; J. H. Tulloch, Lancashire Fortress Engineers; C. H. Steel, Devonshire Fortress Engineers; R. Muir, Lancashire Fortress Engineers; E. H. Bond, Hants Fortress Royal Engineers; A. E. Jones, Hants Fortress Engineers; A. Regan, Hants Fortress Engineers; and D. Lowson, Renfrew Fortress Engineers. Captain and Acting Major F. D. Pyne, O.B.E., A.M.I.E.E., Tyne Electrical Engineers, has relinquished his acting field rank on ceasing to be employed. Major Pyne was commissioned in the Tyne Electrical Engineers in March, 1913, and was posted to No. 2 Company, obtaining his captaincy in June, 1916.

The following appointments have been made at the School of Electrical Lighting:—Chief Instructor, Major P. S. Watkins, D.S.O., R.E.; Instructors, Captain A. S. Millar, R.G.A.; Captain D. R. St. J. J. Ffrench-Mullen, R.E.; Captain and Brevet Major E. O. Alabaster, R.E.; Captain and Brevet Major H. S. Briggs, O.B.E., R.E.; Captain and Acting Major P. F. M. Michell, R.E. Lieut. T. S. Rea, Tyne Electrical Engineers, who was an instructor at the Electric Lighting School, has been restored to the establishment of his corps, of which he was a supernumerary whilst employed as an instructor.

Mr. A. MCKINSTRY, general manager for Australia of the British Westinghouse Electric and Manufacturing Co., who was recently appointed as one of the three Electricity Commissioners for Victoria, has resigned the latter position. Mr. McKinstry has been recalled to England in connection with the business of his company. Mr. R. Gibson, of the Victorian Coal Board, has succeeded Mr. McKinstry.—*Tenders.*

According to *Tenders*, Mr. W. B. HOPKINS, consulting engineer to Messrs. Siemens Bros. & Co., Ltd., and Mr. F. H. LENNARD, export manager, are making a world tour on behalf of the company. They have recently visited the principal cities of the Australian Commonwealth with a view to investigating electrical developments.

Roll of Honour.—Corporal F. A. BOSWORTH, R.F.A., formerly employed at the Rugby works of Messrs. Willans & Robinson, has been killed in action in North Russia. In France he won the Military Medal and bar and the French Medaille Militiare.

Obituary.—Dr. C. A. MERCIER.—On September 2nd, Dr. Charles Arthur Mercier, F.R.C.P., F.R.C.S., died at Bournemouth. He was one of our foremost authorities on mental diseases, and occupied a prominent position in psychology and other scientific studies, having a world-wide reputation. He was best known to electrical men as the fearless and convinced supporter of the process of electrification of seeds, for which remarkably successful results have been claimed, and was a contributor to our columns on this subject. His "Manual of the Electrochemical Treatment of Seeds" was issued last week-end; in the preface he describes how, at first inclined to scoff at the process, he was compelled on investigation to revise his attitude towards it, and felt it to be his duty in the interest of humanity to spread the knowledge of the process as widely as possible.

Sir DUNCAN C. BAILLIE.—We regret to note the death of the chairman of the British Empire Producers' Organisation, Sir Duncan C. Baillie, K.C.S.I., at Glenquaich Lodge, Amulee, on August 30th.

PROF. DESIRE KORDA.—The death is announced from Zurich, at the early age of 55 years, of Prof. Desiré Korda, Professor of Wireless Telegraphy and High-frequency Machines at the Technical High School, Zurich. The deceased, who was born in Hungary, had had a wide experience, and was associated with the construction of the first electric locomotive at the works of the Société de Fives-Lille, France.

EDWIN O. SACHS.—On September 9th, Mr. E. O. Sachs, F.R.S.E., died in his 50th year. He made a special study of fire prevention, and in 1897 founded the British Fire Prevention Committee, of which he was chairman, and which has rendered invaluable services to the community. He was also instrumental in the application of electrical power to the operation of the mechanism of theatre stages.

Will.—The late Mr. SAMUEL L. DORE, a managing director of Baldwins, Ltd., left £205,731, net personalty £153,374.

NEW COMPANIES REGISTERED.

T. W. Jefferson, Ltd. (158,350).—Private company. Registered September 5th. Capital, £10,000 in £1 shares. To take over the business of electrical engineers and contractors carried on as "T. W. Jefferson" at Birkenhead. The subscribers (each with one share) are: T. W. Jefferson, 62, Park Road South, Birkenhead, electrical engineer; E. H. Johnson, 13, Glencoe Road, Liscard, solicitor's managing clerk. T. W. Jefferson is first managing director. Solicitor: P. N. Stone, 1, Union Court, Liverpool.

Acme Electric Traction Co., Ltd. (158,400).—Private company. Registered September 1st. Capital, £20,000 in £1 shares. To take over the business carried on at Acme Works, 688, 700 and 702, Seven Sisters Road, Tottenham, N., as the Acme Electric Traction Co., and to carry on the business of armature winders, winders of all electrical apparatus, electricians, electrical and mechanical engineers, &c. The subscribers (each with one share) are: F. W. Francombe, 3, New Queen Street, Kingswood, Bristol, electrical engineer; J. G. Francombe, 3, Castlewood Road, Stamford Hill, N., electrical engineer; A. Hutchings, A.M.I.E.E., 43, Woodside Park Road, N. Finchley, N., electrical engineer. The first directors are: F. W. Francombe, J. G. Francombe and A. Hutchings. Registered office: Acme Works, 700 and 702, Seven Sisters Road, Tottenham, N.

Eastern Counties Road Car Co., Ltd. (158,379).—Registered August 30th. Capital, £50,000 in £1 shares. To take over all or part of the business carried on in Suffolk by Thomas Tilling, Ltd. Minimum cash subscription 7 shares. The first directors are: C. S. B. Hilton, Manchester Hotel, Aldersgate Street, E.C., director of British Automobile Traction Co., Ltd.; J. E. Spagnoletti, Manchester Hotel, Aldersgate Street, E.C., director of same and of the Brush Electrical Engineering Co., Ltd.; R. M. Tilling, Appin Lodge, Avondale Road, Bromley, Kent, engineer; W. Wolsey, jun., Everley, Wickham Way, Beckenham, Kent, director of Thomas Tilling, Ltd.; C. Reeves, 32, Tavern Street, Ipswich, accountant. Qualification, 250 shares. Remuneration, £50 each per annum (chairman, £50 extra). Any trust deed for securing debentures or debenture stock may, if so arranged, provide for the appointment of a director by the trustees. Secretary: J. Worssam. Registered office: 32, Silent Street, Ipswich.

Cravens, Ltd. (158,475).—Private company. Registered September 3rd. Capital, £10,000 in £1 shares. To carry on the business of contractors for the construction and equipment of railways and tramways, manufacturers of railway and tramway rolling stock, plant, machinery, rails, signalling apparatus and material, &c. The subscribers (each with one share) are: C. F. Spencer, 3, Park Crescent, Southport, accountant; H. Halliday, The Cottage, Preston Hall, Aylesford, Kent, accountant. The subscribers are to appoint the first directors. Solicitors: Walbrook & Hosken, 1, St. Paul's Churchyard, E.C.

Electric Weaving Appliances, Ltd. (4,773).—Private company. Registered in Dublin August 27th. Capital, £5,000 in £1 shares. To purchase or acquire any patent licences, &c., and to carry on business as dealers in spinning and weaving machines. The subscribers (each with one share) are: G. B. Brown, Helens Bay, Down; W. McMurray, Breda Park, Newtonbreda, Belfast. The first directors are not named. Secretary: G. B. Brown. Solicitors: Carson & McDowell, solicitors, Belfast.

J. A. Stevens, Ltd. (158,314).—Private company. Registered September 1st. Capital, £1,000 in £1 shares. To carry on the business of mechanical and electrical engineers, carriers of passengers and goods, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, machinists, &c. The subscribers (each with one share) are: R. Bucgen, 96, Mildenhall Road, Clapton, E.5, clerk; H. Doe, 7, Bruce Road, South Norwood, S.E.25, clerk. Table "A" mainly applies. Solicitor: F. Purchase, 14, Regent Street, S.W.

Hobart Manufacturing Co., Ltd. (158,412).—Private company. Registered September 1st. Capital, £75,000 in £1 shares. To take over the business carried on by the Hobart Manufacturing Co. at Hobart House, Charterhouse Street, E.C., and to carry on the business of manufacturers of and dealers in electrical food-preparing machinery and accessories, meat-chopping machines, coffee grinders and roasters, bakers' and confectioners' machinery, kitchen equipment, lubricants, cements, solutions, enamels, &c. The subscribers (each with one share) are: J. M. Spencer, 314, May Street, Troy, Ohio, director of Hobart Manufacturing Co.; F. H. Wright, 1, Golders Green Crescent, N.W.4, manager. The directors are to number not less than two nor more than five. The Hobart Manufacturing Co., of Troy, Ohio, U.S.A., have the right to appoint four and the company may appoint one. The first directors are: J. M. Spencer and F. H. Wright, both deemed to be appointed by the said American Company. Registered office: 401-3, Birkbeck Chambers, W.C.1.

Vickers-China, Ltd. (158,463).—Private company. Registered September 2nd. Capital, £10,000 in £1 shares. To carry on the business of steel, iron, brass and metal manufacturers and dealers, shipbuilders, shipwrights, ordnance and armament manufacturers, electrical engineers, &c. The subscribers (each with one share) are: E. J. Alldis, 18, Macdonald Grove, E.7, clerk; A. G. Webber, 37, Thornton Street, S.W.9, clerk. The subscribers are to appoint the first directors. Solicitors: Linklater & Cox, 2 Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster, S.W.

J. A. Coomes & Co., Ltd. (158,508).—Private Company. Registered September 4th. Capital, £2,000 in 1,400 ordinary shares of £1 each and 6,000 deferred shares of 2s. each. To carry on the business of mechanical and electrical engineers and scientific instrument makers, &c. Agent with S. H. Henke and others. The subscribers (each with one ordinary share) are: A. W. Ettridge, 17, Edmund Place, E.C.1, merchant; J. E. Kershaw, 140, Milton Avenue, East Ham, E.6, shipping superintendent. The first directors are: A. W. Ettridge (chairman), H. J. A. Coomes and J. E. Kershaw (all governing directors, subject to holding 100 shares each). Registered office: 9a, Plashot Grove, East Ham, E.6.

Middlesbrough Steel Tube and Conduit Co., Ltd. (158,569).—Private company. Registered August 29th. Capital, £15,000 in £1 shares (14,900 ordinary and 100 management). To carry on the business of manufacturers of and dealers in conduit, gas, bedstead, boiler and steel and iron tubes of all kinds, manufacturers of and dealers in electrical and mechanical appliances, &c. The subscribers are: W. H. Mill, 58, Castle Street, Edinburgh, solicitor, 250 shares; J. Mather, Balmoral Terrace, Saltburn, hoop manufacturer, 250 shares; R. W. Perry, Commercial Street, Middlesbrough, tube manufacturer, 500 shares; J. Mill, Traprain, Dundee, merchant, 250 shares. The first directors are: W. H. Mill (chairman), J. Mather, R. W. Perry and J. Mill (all permanent subject to holding £10 management shares each). Secretary: J. Reid. Registered office: Lower Commercial Street, Middlesbrough.

Connollys' (Blackley), Ltd. (158,345).—Private company. Registered August 29th. Capital, £50,000 in £1 shares. Objects: To enter into an agreement with the Enfield Electric Cable Manufacturing Co., Ltd., and its liquidator and the Enfield Ediswan Cable Works, Ltd., for the acquisition of the undertaking and assets therein specified of Connolly Brothers, Ltd., insulated wire and cable manufacturers. The subscribers (each with one share) are: Viscount Grimston, St. Germains, St. Albans; Albert V. Downton, Lesney, Lesney Park, Erith, engineer. The first directors are: Viscount Grimston, John Aspin (Collett Hill, Ware, Herts), Albert V. Downton and John Brown (410, Rochdale Road, Blackley, Manchester). Qualification, 1 share. Remuneration (except managing or technical director), £800 each per annum and any further sum voted by the company. Registered office: Central House, Finsbury Square, E.C.2.

Sydney Boyd, Ltd. (158,333).—Private company. Registered August 28th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of and dealers in motor cars and component parts thereof, manufacturers of electrical appliances and material, motor, electrical and general engineers, metal workers, tool makers, chemical manufacturers, galvanisers, metallurgists, metal coaters and enamellers, &c. The subscribers (each with one share) are: S. W. Boyd, 155, Maida Vale, W., automobile engineer; Mrs. G. L. Harding, 30, West Side, Wandsworth Common, S.W. The subscribers are to appoint the first directors. Solicitor: D. W. Money, 6-7, South Square, Gray's Inn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Robinson & Hands Electrical Co., Ltd.—Mortgage on Mount Street Mills and other premises in Birmingham, registered July 22nd, 1919, to secure all moneys due or to become due from company to Barclay's Bank.

Quain Electric Co., Ltd.—£7,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, registered July 24th, 1919.

L. Weekes, Ltd.—£1,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, registered July 28th, 1919.

CITY NOTES.

Victoria Falls and Transvaal Power Co., Ltd. The report to December, 1918, gives the issued share capital at £3,000,000 and the debenture capital at £3,926,640, a further £150,000 of the 5 per cent. first mortgage debentures having been drawn for redemption during 1918. The net earnings for the year were £864,687. After providing for interest and premium on debentures (£229,715), depreciation and income tax (£410,844), £224,128 remains as net profit, together with £97,691 brought forward, leavng a total of £321,819. Of this £50,000 has been transferred to reserve fund, leaving £271,819. In respect of this balance two dividends, each of 3 per cent., less income tax, were declared on the preference shares for the year ended December, 1918, absorbing £85,501, leaving a surplus of £186,318. On June 19th, 1919, a dividend of 5 per cent., less income tax, on the ordinary shares for the year ended December 31st, 1918, was declared, and as the preference shares are entitled to share *pro rata* with the ordinary shares in the surplus profits distributed until the preference shares have received a total dividend of 10 per cent. for the year in respect of which the distribution is made, the directors at the same time declared a further and final dividend of 4 per cent., less income tax, on the preference shares in respect of 1918. The above dividends (paid on July 8th) absorbed £92,625, leaving a balance to the credit of the profit and loss account of £93,693, which will be carried forward.

Annual meeting, September 19th, at Salisbury House.

Stothert & Pitt, Ltd.—Dividend 12½ per cent., free of tax, on ordinary shares. £12,959 carried forward.

American Telephone & Telegraph Co.—Dividend 2 per cent., less tax, for the quarter.

Brazilian Traction, Light & Power Co.—The revenue for the year to December 31st in Canadian currency was: Revenue under contracts with subsidiary companies, $6,122,412; interest on investments, $130,051; total, $6,252,463; general and legal expenses and interest charges, &c., $832,890; net revenue, $5,419,672; transferred to general reserve, $250,000; dividends No. 20, 21, 22, and 23 at 1½ per cent. each on preference shares, $600,000; surplus carried forward, $4,569,672. The total gross earnings of the subsidiary companies in Brazil for the year were 101,894,163 milreis (against 92,200,319 milreis in 1917), the operating expenses were 49,762,628 milreis, and the net earnings 52,131,535 milreis, against 47,072,868 milreis in 1917. Notwithstanding the difficulties experienced in obtaining supplies of telephone material, it was possible to complete the toll line connecting the cities of Rio de Janeiro and San Paulo and the intermediate towns, and to add nearly 8,000 subscribers to the system.

Trowbridge Electric Supply Co., Ltd.—Net profit on year's working £372, which, with £57 brought forward, totals £429. After payment of 5 per cent. dividend on the ordinary and preference shares (£165), transferring £200 to the depreciation fund, there is a balance of £64 to be carried forward.

Kalgoorlie Electric Tramways, Ltd.—The accounts for 1918, after providing for interest and sinking fund on the "A" debenture stock, and charging interest (not paid) on the "B" debenture stock, show that the deficit balance of £30,519 brought down was further increased to £36,519.—*Financial Times.*

Chilian Electric Tramway & Lighting Co., Ltd.—According to the *Financier*, the Public Trustee invites tenders for the purchase of 650,000 6 per cent. cumulative preference and 403,193 ordinary shares of £1 each of the Chilian Electric Tramway & Light Co., Ltd.

Madras Electric Tramways, Ltd.—Interim dividends 6 per cent. per annum, less income tax, on the preference shares and 8 per cent. per annum, free of income tax, on the ordinary shares.

Clyde Valley Electrical Power Co.—Interim dividend of 2 per cent., less tax.

STOCKS AND SHARES.

Tuesday Evening.

Business in the Stock Exchange is far from being slack. Several of the leading markets are reasonably active. Rubber shares provide a living for those closely connected with the animation that has followed a further rise in the produce. The buying of Home Railway stocks died away to some extent, though prices maintain most of their improvement. A feature of the week has been lively dealings in the Marconi market, more especially in the shares of the American and Marine subsidiaries. Industrials attract a degree of interest, which declines to be overborne by Labour conferences, Archangel controversies and foreign rates of exchange.

Electric lighting shares display no new developments. The market is not quite dead, but it is distinctly dormant. A well-known firm connected with this department has issued a useful sheet of particulars from which we may supplement the information given in our tables. At the present time it is of importance to know the cost of land and buildings, &c., to each company, as this may have a bearing upon whatever situation arises from the Government's Electricity Bill. In the following list, the issued capital of each company is given, the figures including debenture stocks as well as ordinary and preference shares:—

Company.	Capital Issued.	Cost of Land and Buildings.	
Brompton & Kensington	£300,000	Lands	£72
		Buildings	29,689
Charing Cross (West End)	£1,245,736	Purchase station, mains, lands, buildings, &c.	110,744
		Additional expenditure land and buildings	157,588
Chelsea	£398,968	Land & freehold buildings	154,180
		Leasehold buildings	28,157
City of London	£1,805,950	Buildings	238,130
		F. & L. land and buildings	160,323
		Warehouses, &c.	53,876
County of London (Metropolitan areas only)	£2,405,780	F. & L. lands	85,737
		Buildings	158,148
Kensington and Knightsbridge	£295,000	Lands	30,684
		Buildings	33,946
London	£1,369,555	Freehold lands and buildings	147,004
Metropolitan	£2,240,705	Lands	37,548
		Buildings	448,349
Notting Hill	£209,352 10s.	Freehold lands	10,443
		Leasehold	2,218
		Buildings	24,652
St. James	£450,000	Freehold land	126,207
		Buildings and paving	111,063
South London	£430,000	Freehold land	11,262
		Buildings, paving and railway sidings	67,397
South Metropolitan	£686,424	Freehold land and riverside wharf	12,546
		Buildings	72,068
Westminster	£1,226,300	Lands	72,317
		Buildings	291,084

American Marconis enjoyed a sharp rise from 29s. to 33s. 6d. on rumours that the company may be taken over by the General Electric of New York. Profit takers promptly reduced this to 32s. 3d. Canadians hardened to 15s. 6d. Marconi Marines went ahead to 3 3-16, a rise that will not surprise those who have followed these notes for the past two or three weeks. The parent shares gained 3-16, but in their case any incipient buoyancy has been somewhat checked by sales from the Continent.

Cable stocks are firm as a whole, and Anglo-Americans improved, the preferred rising 1½. The investor who is hard up for profitable channels in which to place his money might do worse than study the various cable and manufacturing issues quoted in our lists, upon which dividends are distributed free of income-tax.

British Aluminium shares and British Westinghouse preference both stand higher on the week. Rubber has risen from its recently lowest price of 1s. 8d. per lb. to 2s. 4½d. per lb., and this has served to ferment a favourable market to holders of rubber shares. As to the lasting character of the rise, there appears to be some little doubt, unless the raw produce should continue to ascend.

Brazilian Tractions rose 2 to 60 on the issue of the report, which is considered hopeful. The preference at 90 were quoted ex dividend to-day, Tuesday. Mexicans are heavy, Mexico Tramways fives are 2 lower, and a similar fall has left Mexican Light and Power Seconds at 39½. Sao Paulo First Mortgage bonds declined to 94½. Shawinigan Water Common eased off to 140. Madras ordinary at 19s. have gained a shilling, and Calcutta ordinary at 8½ are ¼ up. Brisbane Electric Investment ordinary at 5½ show a small loss.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Sep. 9, 1919.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	6xd	—	£5 13 4
Charing Cross Ordinary	4	4	3½	—	7 5 6
do. do. 4½ Pref.	4½	4½	3	—	7 10 0
Chelsea	5	5	3	—	5 0 0
City of London	8	8	1⅛	—	6 17 8
do. do. 6 per cent. Pref.	6	6	3½	—	6 3 1
County of London	7	7	3½	—	7 7 5
do. do. 6 per cent. Pref.	6	6	3½	— ¼	6 6 4
Kensington Ordinary	7	6	5	—	6 0 0
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	5	5	3⅝	—	8 5 6
Metropolitan	4	5	2½	—	8 18 10
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 1 2
St. James' and Pall Mall	9	10	6½	—	8 0 0
South London	5	5	2½	—	7 5 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	96	+1½	6 5 0
do. Def.	1½	83/5	24½	+ ⅛	7 9 0
Chile Telephone	8	8	6½	—	5 18 6
Cuba Sub. Ord.	7	7	10½	—	*5 13 4
Eastern Extension	8	8	15½	—	*5 6 0
Eastern Tel. Ord.	8	8	159/8	—	*5 0 4
Globe Tel. and T. Ord.	7	8	15½	—	*5 5 0
do. do. Pref.	6	6	10⅜	—	5 18 6
Great Northern Tel.	22	22	28⅜	—	7 14 5
Indo-European	13	13	51½	—	6 6 3
Marconi	20	25	5⅜	+ 3/16	4 13 2
Oriental Telephone Ord.	15	10	2½	—	4 9 0
United R. Plate Tel.	8	8	7⅛	—	*5 8 3
West India and Panama	1/8	1/8	1/16	—	*4 15 3
Western Telegraph	8	8	15½	—	*4 18 9
HOME RAILS.					
Central London Ord. Assented	4	4	60½	—1	6 12 1
Metropolitan	1	1½	26½	—	4 14 2
do. District	Nil	Nil	10	—	Nil
Underground Electric Ordinary	Nil	Nil	2½	—	Nil
do. do. "A"	Nil	Nil	8/0	—	Nil
do. do. Income	4	5	94½xd	—1	*5 5 9
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4½	—	6 13 4
Anglo-Arg. Trams. First Pref.	5½	Nil	3	+ 1/16	—
do. do. 2nd Pref.	—	—	2½	— ⅛	—
do. do. 5 Deb.	5	5	6b	—	7 13 10
Brazil Tractions	—	—	60	+2	—
Bombay Electric Pref.	6	6	12½	—	4 18 6
British Columbia Elec. Rly. Pfds.	5	5	55½	—	9 1 10
do. do. Preferred	Nil	2½	4½	—	5 7 6
do. do. Deferred	Nil	Nil	19	—1½	Nil
do. do. Deb.	4½	4½	66	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	55	—2	Nil
do. 6 per cent. Bonds	Nil	Nil	45½	—	Nil
Mexican Light Common	Nil	Nil	18	—	Nil
do. Pref.	Nil	Nil	48½	—	Nil
do. 1st Bonds	Nil	Nil	60½	—1	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	18	18	32	—	*4 2 9
British Aluminium Ord.	10	10	1½	+ 1/16	b a a
British Insulated Ord.	25	12½	2⅞	—	b 1 0
British Westinghouse Pref.	7½	8	3⅞	+ 1/16	4 1 b
Callenders	25	25	9	—	b 19 6
do. 6½ Pref.	5	6½	3½	—	b a 10
Castner-Kellner	25	20	2½	—	b 0 0
Crompton Ord.	7	10	21/6	—	b 6 0
Edison-Swan, "A"	—	—	1½	—	b 0 0
do. do. 5 per cent. Deb.	4	5	81½	—	b 2 9
Electric Construction	10	10	14	—	b 16 0
Gen. Elec. Pref.	6	6½	1	—	b 10 0
do. Ord.	10	10	3	—	*5 0 0
Henley	25	25	2⅛	—	b 8 0
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	10	17	—	*5 17 8
Siemens Ord.	—	10	1⅛	—	*7 17 0
Telegraph Con	20	20	25	—	*4 17 0

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, September 9th.

CHEMICALS, &c.		Latest Prices.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	..
a Ammoniac Gal	per ton	£80	..
a Ammonia, Muriate (large crystal)	"	£76	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£80	..
a Copper Sulphate	"	£42	£4 dec.
a Potash, Chlorate	per lb.	1/1	..
a " Perchlorate	"	1/5	..
a Shellac	per cwt.	£24 10	£4 dec.
a Sulphate of Magnesia	per ton	£20	..
a Sulphur, Sublimed Flowers	"	£28	..
a " Lump	"	£ 0	..
a Soda, Chlorate	per lb.	8d.	..
a " Crystals	per ton	£70/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£88 to £292	..
c Brass (rolled finish on 18 basis)	per lb.	1/1½	½d. dec
c " Tubes (solid drawn)	"	1/5 to 1/5½	..
c " Wire, basis	"	1/4	..
c Copper Tubes (solid drawn)	"	1/7½	..
g " Bars (best selected)	per ton	£140	..
g " Sheet	"	£146	..
g " Rod	"	£140	..
d " (Electrolytic) Bars	"	£120	£5 dec.
d " " Sheets	"	£128	..
d " " Wire Rods	"	£128	£5 dec.
d " " Wire	per lb.	1/2½	1d. dec.
f Ebonite Rod	"	3/-	..
" Sheet	"	2/6	..
h German Silver Wire	"	2/6	..
h Gutta-percha, fine	"	10/- to 11/-	..
h India-rubber, Para fine	"	2/5½	..
i Iron Pig (Cleveland warrants)	per ton	£5	..
f " Wire, galv. No. 8, F.O. qual.	"	£42	..
g Lead, English Pig	"	£26 5	5/- inc.
g Mercury	per bot.	£2a to £24 10	..
e Mica (in original cases) small	per lb.	6d. to 8/6	..
e " " " medium	"	8/- to 10/-	..
e " " " large	"	12/6 to 25/- & up	..
g Phosphor Bronze, plain castings	"	1/6½ to 1/7½	..
g " " rolled bars & rods	"	2/- to 2/4	..
g " " rolled strip & sheets	"	2/1 to 2/5	..
k Silicium Bronze, rods	per lb.	1/9	1d. inc.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	£279 to £280	£11 inc.
n Wire, Nos. 1 to 18	per lb.	4/6	..
White Anti-friction Metals	per ton	£60 to £292	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
k Richard Johnson & Nephew, Ltd.
n F. Ormiston & Sons.
r W. F. Dennis & Co.

Careers for ex-Service Men.—One of the most important features of the measures for resettling ex-service men in civil life is the Government scheme whereby ex-officers and other ranks of good education may be assisted to take up or resume training for business and professional careers. In the phase of the work dealt with by the Appointments Department of the Ministry of Labour, training is arranged for in offices and works, &c., and the co-operation of employers is therefore essential to success. Many employers have responded to the appeal which has been made to them with the greatest willingness, and although the scheme has only been working fully for a comparatively short time, over 3,500 students are now in training. Engineering is a profession which is greatly sought by candidates, and at August 22nd there were 602 students training in the various branches of the profession. The number of applicants is, however, very greatly in excess of the number of training vacancies available, and employers who can help by offering to train suitable candidates are urgently requested to communicate with the nearest district office of the Appointments Department. It should be added that in cases where it is proved necessary, grants are made to students to assist in payment of their fees and maintenance during the period of training.

Wireless Society of London.—We understand that the officials of the Wireless Society of London are in close touch with St. Martins-le-Grand on the question of licences. It will be remembered that before the war they appointed a strong advisory committee to assist the officials of the Post Office in sifting their numerous applications for licences, and recommending those which should be accepted. The hon. secretary, Mr. Leslie McMichael, of 30, West End Lane, West Hampstead, N.W. 6, informs us that the offer of their services has again been accepted in the same capacity. Several questions in connection with the proposed new licences have still to be decided, particularly with respect to transmitting, but we gather that the genuine experimenter and the amateur who is prepared to conform to reasonable regulations, may rely upon the society doing all that can be done at the moment to further their interests.

MERZ-PRICE PROTECTION FOR ALTERNATORS AND TRANSFORMERS.

By C. W. MARSHALL.

For feeder protection the current transformers used for Merz-Price gear are connected up in opposition, but for alternators and transformers a different system is generally used. To illustrate this system, consider the arrangements for a single-phase alternator as shown in fig. 1. A current transformer is connected at each end of the alternator stator winding, and the secondaries of these transformers are connected in conjunction by means of pilot wires of suitable capacity. From the middle points of the pilots, connections run to the relay R. If the current transformers are identical, the pilots uniform, and the primary currents of the transformers are equal, the relay will be connected across equipotential points. Under these conditions no current will pass through the relay. This state of affairs holds when the alternator winding is sound. If, however, a fault develops in the alternator winding which causes a difference in the currents which traverse the current transformer primaries the middle points of the pilots are no longer at the same potential, and current flows in the relay windings. When the fault current reaches a certain magnitude determined by the characteristics of the current transformers and relay used, the relay will operate and open the alternator oil switch.

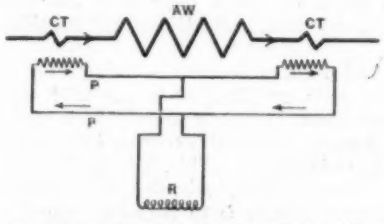

Fig. 1.—C T, current transformer; R, relay; A W, alternator stator winding; P P, pilot wires.

Fig. 2 gives the arrangement for a 3-phase alternator. This will be seen to be merely an extension of the scheme outlined above. The current transformers at the outgoing ends are situated so as to guard against faults in instrument transformers and cabling. Arrangements are also made to break the field of the alternator automatically whenever the oil switch is operated by means of the Merz-Price relay. Many schems have been proposed in this connection to ensure that the field circuit is not broken until the oil switch has opened. The writer is, however, of the opinion that such devices are generally quite unnecessary, provided that the whole of the operations of opening oil switch and field-break switch are done rapidly (within about 0.5 sec.). This opinion is based on the fact that the main field of one of the principal units (6,000 K.V.A.) on a large system, has been repeatedly broken for periods of about 10 secs. without seriously upsetting the voltage or power factor. The machine referred to had a cylindrical rotor.

Many engineers use light fuses in parallel with the relays owing to the danger of sound machines being disconnected from the busbars, when faults occur on other parts of the system. This practice greatly detracts from the sensitiveness and speed of operation of the protective gear, and is not to be recommended.

Merz-Price gear as described above has given good service, but it must not be forgotten that it does not protect against power reversal or faults between turns of the same phase.

For star/star or delta/delta transformers, the simple scheme shown in fig. 2 is generally used, but the relays are invariably provided with parallel fuses, and a second set of heavy fuses is introduced into the pilot wires so as to guard against overload. The current transformers in the primary and secondary circuits have their transformation ratios inversely proportional to the voltage ratio of the power transformer.

For delta/star transformers, the arrangement is slightly more complicated, and is shown in fig. 3. In this figure the numerical values inserted

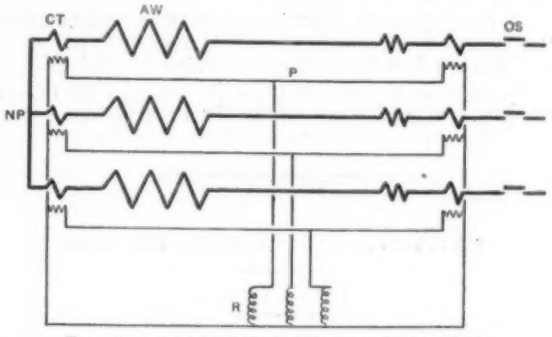

Fig. 2.—N P, neutral point; O S, oil switch.

give data for a 6,600/440-volt, 1,000-K.V.A. transformer. The principal point to note is the fact that the current transformer secondaries on the low-tension side are delta connected, so that the currents in the pilot wires may be approximately in phase with the secondary currents from the high-tension side current transformers. The same result could be obtained by connecting the high-tension current transformers delta and the low-tension ones star, in which case the latter transformers would be wound for $5\sqrt{3}$ amps. on the secondary. Owing to the unbalancing produced by the magnetising current and by the changing of the tappings, it is not possible to get stationary equipotential points, and the connections to the relays are taken from any convenient points of the pilots. The size of the over-

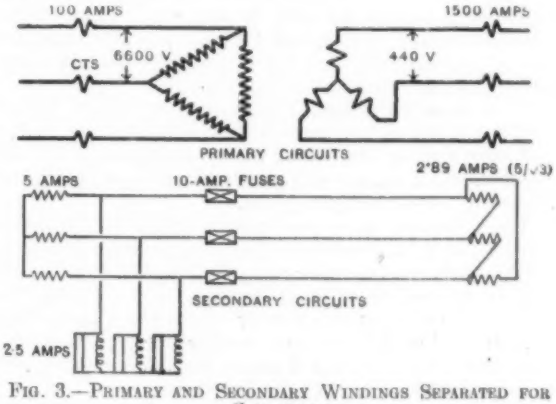

Fig. 3.—Primary and Secondary Windings Separated for Clearness.

load fuses depends on local conditions, while the fuses in parallel with the relays are made as light as possible. The relay impedence should be high enough to ensure that the fuse must blow before the relay will operate. It will be seen that no very high degree of sensibility can be obtained with this class of gear, and the case for biased relays is still more evident than with balanced-voltage feeder protection.

Apparatus.—The current transformers used for circulating current systems are of the standard types used for operating measuring instruments. For good results they should have a minimum of about 500 amp.-turns. On large systems, where the possible short-circuit currents are very great, both primary and secondary windings should be of ample cross section.

The pilot wires used are generally incorporated in a multicore cable, each core consisting of about 7/20. The practice of displacing the equipotential points by means of resistances in order to save cable is generally unsatisfactory.

Fuses.—Great care must be taken to ensure that the fuse holders used are of sound construction, as many cases of faulty operation have been traced to flimsy fuse clips.

Relays.—These are of the electromagnetic type, as used for feeder protection, but are generally of somewhat lower impedance.

Development of Merz-Price gear has been practically at a standstill for several years, and although the system has been of great value in maintaining continuity of supply, it is to be hoped that newer devices will be introduced in the near future.

PAYMENT ON POWER FACTOR.

By L. C. GRANT.

A BETTER working power factor means improved conditions for all concerned, and in these days of economy and reform it is a matter that demands immediate attention.

From the power companies' point of view it is advantageous, in that it enables better running conditions to be maintained by using all existing plant to its fullest capacity, without having to expend money in copper merely to carry an idle current. The same, of course, applies to switchgear, feeders, mains, &c. Then, we have that by no means unimportant point, better regulation and safer operation, to take into consideration, as by working with a minimum angle of lag we remove the demagnetising effect of the stator flux, which a lag in current always produces.

As regards charging the consumer, something will depend upon whether the existing supply is metered by means of ampere-hour or watt-hour meters. In the former case, unless some allowance has already been agreed upon, the supply people will naturally be somewhat reluctant to charge upon any but ampere-hour readings, and since, as a rule, they are not actuated by any very well-developed altruistic motives, it is doubtful whether, at any rate in the case of a small consumer, the power companies have taken power factor into consideration at all.

With watt-hour meters, it becomes of advantage to both parties to go into the power factor question as the meter will only register the actual energy consumed, and as all installations, except the very smallest, are so equipped, this affects an overwhelming majority.

The consumer has several circumstances in his favour which alone should exert considerable influence, apart from anything the supply company may be prepared to do in the way of rebates, or what is, perhaps, more effective, the introduction of a variable penalty as the power factor falls off. He will get a better and steadier voltage, which will, if he uses the same source of supply for lighting, cause him to appreciate the change to the fullest extent.

If he is prepared to go to the expense of the changes, or if he is connecting up new plant, commutator or compensated motors should be chosen, which will result in his having less expenditure for plant, cables, and switchgear, as these will only have to carry actual working loads, in consequence of the excellent power factor of this class of motor.

The modern commutator or compensated motor has characteristics which an ordinary induction motor can never approach. The old argument regarding the extreme robustness of the induction motor is based almost entirely upon the fact that it has a practically indestructible rotor; the slip-ring and wound-rotor motors do not approach the squirrel-cage motor in this respect. No attempt is made to depreciate this valuable feature; but when we have a number of arguments in each of which the induction motor is at a disadvantage, it must be obvious that there is, in most respects, a better argument for the other side.

The commutator motor of to-day is an entirely different piece of engineering to what it was 15, or even 10 years ago, both from the point of view of mechanical and electrical stability and also in that it operates upon a different principle. The two must not on any account be confused.

It is a motor which has been evolved to fill a want, and the requirements it was designed to comply with, are:—Strength and reliability; efficiency; improved power factor; and it meets them all.

Another point in its favour, is that it is not necessary to work with a minimum air gap as with an induction motor, but it works with quite a reasonable clearance; in fact, it can work with any clearance, as magnetic leakage can be compensated for in the design.

In those cases in which a large amount of power is consumed and high starting torque is not an essential, the self-starting synchronous motor presents first-rate possibilities; with it we have dead steady speed, remarkably high locking or synchronous torque, and complete power-factor control over a practically unlimited range of lag and lead. The ease with which this control can be carried out makes it sometimes worth while to install one purely for power-factor compensation, *i.e.*, loading it up entirely with wattless current at a wide angle of lead to compensate for induction motors, transformers, &c.

Other means available for power factor correction are rotary and vibratory phase-advancers and static and rotary condensers, the latter being merely unloaded synchronous motors.

The rotary phase-advancer, usually driven by the motor itself, as well as the vibratory pattern, is usually reserved for large plant in which their need has already been appreciated, and fitted at the time of the installation of the motor.

Static condensers, on account of their having no moving or working parts, are likely to be the most useful to the average consumer, and have already been used to a fair extent in America, but in this country little encouragement is given to install them. This, it is needless to mention, except for the sake of emphasis, should be remedied at once.

For his own sake, it is to the advantage of the user to run at the best possible power factor, but when it comes to a question of penalties, as it must inevitably do before long, the fact will be demonstrated in a remarkably effective manner, and then the least progressive will have to "get a move on." It is, however painful may be the admission, an undeniable, and even glaring, fact that the only way to produce any appreciable operation of the faculties of the majority is to touch the pocket, safe, or bank balance, as the case may be. On this assumption, the introduction of a power-factor charging system is likely to produce the desired effect in the most reasonable time; and while there is no doubt that it is always to the user's advantage to look after his power factor, it will take the introduction of a charging system of this sort to attract the attention that the matter needs.

In some cases a number of consumers could work together with a system of condensers; but probably the best way will be to collaborate with the supply companies, as this enables the technical knowledge and experience of the latter to be put into use. Then, of course, there will be decreased expenditure if a centralised system is adopted.

In America, as already mentioned, the power-factor idea is rapidly catching on, and in New England and Boston contracts now embody a clause penalising those consumers having a bad power factor.

In New England, the greatest phase angle allowable without extra charge is 0·8 lead. Below this and down to 0·7, a 5 per cent. penalty is imposed, being gradually increased until at 0·5, a 50 per cent. penalty has to be borne.

This is all to the good, and the only improvement that seems possible is that a closer approach to unity should be insisted upon, although this point will depend upon local circumstances. For instance, some supply authorities have a fair amount of synchronous plant, also feeders, &c., having electrostatic capacity, and all tending to produce a leading current. Then, if too close a margin were insisted upon, it is obvious that at certain periods, the generators might very easily have to carry a heavy leading current.

TREE TELEPHONY AND TELEGRAPHY.

The following is an abstract of a paper communicated to the *Journal* of the Franklin Institute, June, 1919, by Major-Gen. George O. Squire, Ph.D., Chief Signal Officer, U.S. Army:—

In 1904 the author conducted some experiments with a view to utilising growing trees as antennæ for wireless telegraphy and discovered the efficacy, in a general way, of using a direct metallic contact to certain trees (principally eucalyptus) to increase the audibility of wireless signals.* His attention was first called to this phenomenon during summer manœuvres of the army in California, where, due to the prevalence of the dry season and the unusual character of the soil, it was found that the regular army buzzer telephone and telegraph sets were inoperative with any ordinary earth but became operative when connected to a metallic nail driven in the trunk or roots of a tree.

It would seem that living vegetation may play a more important part in electrical phenomena than has been generally supposed. Living vegetable organisms absorb and conduct

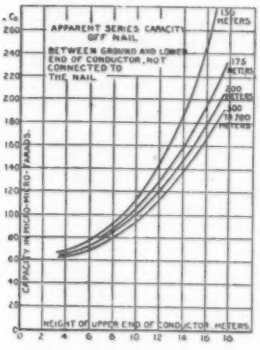
APPARENT SERIES CAPACITY OFF NAIL
BETWEEN GROUND AND LOWER END OF CONDUCTOR, NOT CONNECTED TO THE NAIL
150 METERS
175 METERS
200 METERS
300 TO 700 METERS
CAPACITY IN MICRO-MICRO-FARADS
HEIGHT OF UPPER END OF CONDUCTOR METERS

Fig. 1.

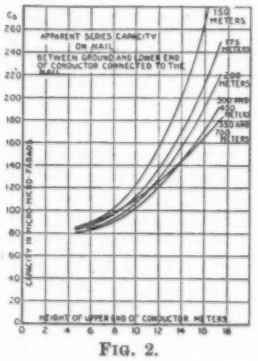
APPARENT SERIES CAPACITY ON NAIL
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Fig. 2.

electromagnetic oscillations over a wide range of the electromagnetic spectrum, beginning with sunlight, whose electrical action in the plant cell is at present little understood, and extending to waves of identical character, but of immensely greater lengths, such as Hertzian radiation, telephonic waves, and oscillations of the ordinary low frequencies used in commercial electric transmission lines. Disruptive discharges between vegetable electrodes and electrostatic effects between vegetable surfaces are easily produced. A growing tree, covered with foliage, is influenced inductively by electrical disturbances outside of itself, and in fact becomes generally responsive to induced electrical oscillations. It should offer, therefore, a promising means of studying meteorological effects of an electrical character, particularly those of lightning discharges and electricity of the air. Has not the time arrived for a more systematic study of physical botany, in the light of the new electrical theory of matter?

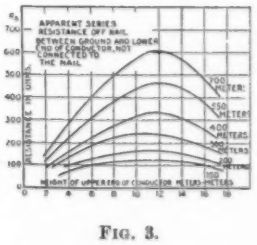
APPARENT SERIES RESISTANCE OFF NAIL
BETWEEN GROUND AND LOWER END OF CONDUCTOR, NOT CONNECTED TO THE NAIL
RESISTANCE IN OHMS
HEIGHT OF UPPER END OF CONDUCTOR METERS

Fig. 3.

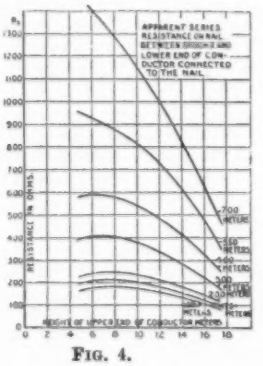
APPARENT SERIES RESISTANCE ON NAIL
BETWEEN GROUND AND LOWER END OF CONDUCTOR CONNECTED TO THE NAIL
RESISTANCE IN OHMS
HEIGHT OF UPPER END OF CONDUCTOR METERS

Fig. 4.

In connection with the development of trans-Atlantic wireless reception carried out during the war to provide against the possibility of the interruption of the submarine cable system, the Signal Corps established a chain of special receiving stations in different parts of the U.S.A. to copy and record enemy and allied wireless messages from European stations for the information of the Army General Staff. In the prosecution of this work, and with apparatus representing the most advanced state of wireless art, the problem, as a war measure, was attacked anew.

It was immediately discovered that with the sensitive amplifiers now in use it was possible to receive signals from the principal European stations by simply laying a small wire netting on the ground beneath the tree and connecting an insulated wire to a nail driven in the tree well within the outline of the tree top. One of the best receiving arrangements is found to be an elevated tree earth-terminal in the upper part of the tree top as described later, and an earth consisting practically of several short pieces of insulated wire sealed at the outer ends radiating out from a common centre, and buried a few inches beneath the surface of the ground in the neighbourhood of the tree.

It was soon found that a tree-antenna could be used efficiently as a multiple receiving set over widely different wave lengths, receiving either from separate terminals at the same or different heights of the tree or in series from the same terminal. This same type of circuit was employed in an inverse manner for telephonic transmitting purposes, and although the experiments thus far have been limited to short distances, it was found that 2-way telephonic communication was easily established with remarkably low values of transmitting antenna current. The linking up of wire and wireless methods was found to be convenient and efficient. Wireless telephonic messages from airplanes were readily received by the tree-antenna arrangement and transferred thence to the wire system of the City of Washington and finally received at any point desired. Furthermore, telephonic transmission through the tree-antenna was received by another tree-antenna, and automatically returned to the sender on a wire system, thus making the complete circuit. Long-distance reception on any wave length from all the larger European stations and from ships at sea was easily accomplished and messages received on a twenty-four-hour schedule by the regular enlisted operators of the Signal Corps. Early experiments served to ascertain the relation between the audibility of received signals and the height of the tree contact above the ground, but gave no data concerning the magnitudes of the electrical properties which characterised such an antenna system. It is the intention here to examine more closely such properties.

The following experiments were made on a pine tree, the average diameter of which was about 25 cm.

Tree contact was made through copper nails driven 3 in. into the tree; earth contact was made through a bundle of copper wires buried 3 ft. deep in moist soil. Three earths were installed so that the individual resistances could be determined. An average value for this resistance with D.C. was 150 ohms. At wireless frequencies, on account of capacity effects, this resistance was much smaller.

Using the substitution method, measurements of the apparent series capacity and resistance of the lead alone and of the lead attached to nails driven into the tree at various heights were made at different frequencies. In all cases the lead was of just sufficient length to reach to the point of contact, whether connected electrically to the nail or free.

From the data so obtained after cross-plotting to eliminate irregularities, consistent and regular families of curves, as shown in figs. 1, 2, 3 and 4, were obtained. Wave lengths from 150 to 700 metres were covered.

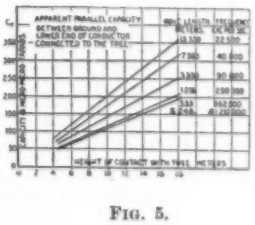
APPARENT PARALLEL CAPACITY BETWEEN GROUND AND LOWER END OF CONDUCTOR CONNECTED TO THE TREE
HEIGHT OF CONTACT WITH TREE METERS

Fig. 5.

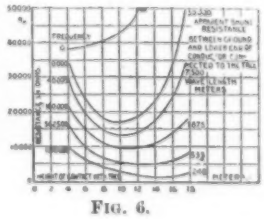
APPARENT SHUNT RESISTANCE BETWEEN GROUND AND LOWER END OF CONDUCTOR CONNECTED TO THE TREE
WAVE LENGTH METERS
HEIGHT OF CONTACT WITH TREE METERS

Fig. 6.

The small change in the electrostatic capacity occasioned by making electrical contact with the tree, while all other conditions remain unaltered, is to be noted, and also the large increase in resistance under the same conditions. The increase in resistance is particularly pronounced for small heights and long wave lengths. No correspondence is to be observed between the resistance curves, as determined by these measurements, and the radiation resistance curves of a simple vertical wire. The explanation of such large resistance values in case of tree antennæ is probably to be found in the effect of the immediate proximity of partially conducting media to the conducting lead.

For long waves (low frequencies) the substitution method was not found satisfactory, so the method in which an antenna of unknown properties is shunted around a condenser which constituted a portion of a resonant circuit was used. This method of measurement yields the apparent values of the antenna constants when they are considered as elements in parallel.

For the data so obtained the antenna lead was connected to the tree, and from it, after cross-plotting to eliminate accidental errors, the curves shown in figs. 5 and 6 were obtained.

*"On the Absorption of Electromagnetic Waves by Living Vegetable Organisms." By George O. Squier. Official Report to the War Department on the Military Manœuvres in the Pacific Division, 1904.

The apparent capacity curves in fig. 5 indicate a capacity proportional to the height of contact. Besides showing capacity and resistance as functions of height of contact, they may also be plotted as functions of frequency, or, as in this case, the square root of frequency. Such curves are shown in figs. 7 and 8. Taking a number of representative points from these curves of apparent shunt characteristics, the values of the equivalent characteristics were calculated and the data shown plotted in figs. 9 and 10 were thus obtained. Discrepancies indicated by a comparison of those portions of the curves in figs. 7 and 8 and of those in figs. 2 and 4 which overlap may be explained by the fact that the measurements were made at different dates and after the tree had undergone widely different weather conditions.

The foregoing curves show that, in general, the effective antenna resistance is many times the apparent resistance of antennæ as ordinarily used, and that, therefore, the design of receivers should be materially altered in order to utilise to the best advantage the energy impinging upon the tree. Except for very weak signals, however, receivers of present-day design may be used, and they are responsive to any wave length of radiation.

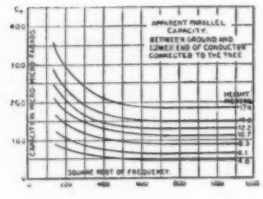

Fig. 7.

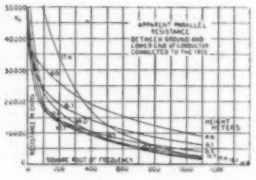

Fig. 8.

The determination of the open-circuit electromotive force has not, so far, been accomplished with reference to the particular problem in hand, apparatus of sufficient sensitiveness not being available. Indirect methods may, however, be used, and from them comparative results of fair accuracy may be expected. An outline of one such indirect method is given below :—

The open-circuit voltage of the tree system as an antenna is to be determined for different heights of contact and for different frequencies. To be of use in determining the behaviour of the antenna system, without reference to a particular sending station, this open-circuit voltage must be that for unit field strength of impinging radiation. This can be

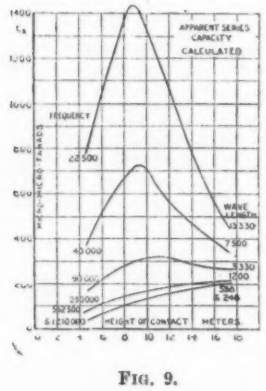

Fig. 9.

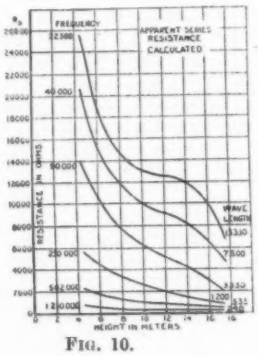

Fig. 10.

determined by dividing the observed value of voltage by the calculated field strength set up by the particular sending antenna. To make observations a simple form of antenna for which the open-circuit voltage can be calculated in terms of the field strength may be used, such as a simple vertical wire. After the apparent properties at the various frequencies which are to be used have been determined, connect in series with this antenna (also shunting it by a capacity to earth if necessary) such resistance and capacity as to make its total constants equal to the apparent constants of the antenna whose open-circuit voltage is desired. Then arrange for the alternate connection of these two antenna systems to a receiving set and associated audibility meter. The readings of the audibility meter which give equal intensity of signals then correspond approximately to the square of the open-circuit voltages. The open-circuit voltage of the simple antenna being calculable, the value of the voltage for the unknown system becomes known. To eliminate from the calculations this law concerning rectification, the antenna may be loosely coupled to the receiving set and the coupling varied for the two systems until equal signals are received, thus eliminating the audibility meter—a device not at present very dependable. For equal signals the ratio of such coupling is inversely proportional to the open-circuit E.M.F. because the impedances of the two antenna systems were originally made equal.

From field experiments certain data are available giving the audibility of signals as received with a portable heterodyne receiver and two-stage amplifier connected to a large poplar tree as an antenna. With the receiving set tuned to give the best signal strengths, data concerning the audibilities at different heights of contact were obtained as in fig. 11, in which audibilities are shown as functions of the height of contact. The wave lengths are indicated on the curves. Very great increase in audibility occurs at about 12 metres height (about two-thirds of the total height of the tree). Since the audibilities are approximately proportional to the square of the E.M.F. applied to the receiving set used at a given frequency. The curves, fig. 12, except for values above 12 metres in height, are quite closely approximated by straight lines. Theory would lead to the conclusion that the open-circuit voltage is a straight-line function of the height, and, since the receiving set was tuned to maximum sensitiveness for each reading so that the total reactance of the circuit was zero, the remaining quantity to which must be attributed the departure of these curves from straight lines is the variable (and in this case unknown) antenna resistance. It is suggested that had the total resistance of the antenna system been maintained constant by the insertion of series resistance of the proper value, the curves in fig. 12 would approximate very closely to straight lines. The trees on which the impedance and audibility measurements were made were practically equal in height, so that it is reasonable to suppose that similar phenomena would be observed in both. The height at which the audibility curves show their sharpest upward trend, which is also the same height for which the square roots of the audibilities depart from the straight-line relation, is also the height at which the apparent shunt resistance reaches a minimum

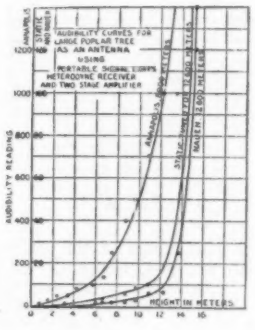

Fig. 11.

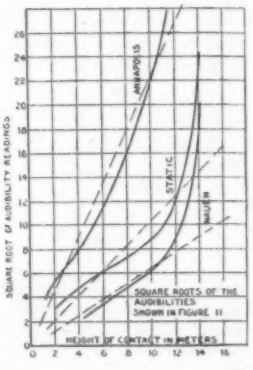

Fig. 12.

value in fig. 6, for the wave lengths involved in the audibility measurements. Although the term "open-circuit voltage" has been introduced, it should be recognised that it corresponds to the "effective height."

Some applications of direction-finding methods have been applied to tree antenna. It is possible to make use of a coil aerial in combination with the tree system, without in any way detracting from the remarkable simplicity of the tree system, for obtaining undirectional reception. The circuit shown in fig. 13 consists of the coil aerial L_1, the industance L_2, and the capacity C_2. This circuit to which there is connected the detector and amplifier forms the secondary receiving cir-

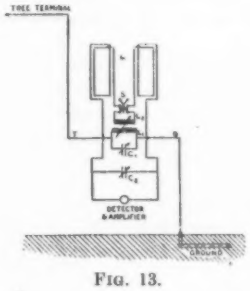

Fig. 13.

cuit of the system and is coupled inductively to the primary circuit L_2C_1 to which the tree and earth wires are connected at T and G.

The system is unique in that both primary and secondary circuits are directly exposed to the incoming wave. It is by virtue of this double exposure that the unidirectional characteristic of the system is obtained. In other words, both primary and secondary circuits are simultaneously operated upon by the incoming electromagnetic wave and by the proper adjustment of the linking coils L_1 and L_2, the effects produced in the secondary circuit may be entirely neutralised or accumulated. The reversing switch S connected to coil L_2 controls this neutralising or accumulating effect.

Complete "barrage" effect was obtained with this system on stations such as New Brunswick, New Jersey; Annapolis, Maryland; Nauen, Germany, &c. This makes it possible, for

example, to receive signals from San Diego, California, while the New Brunswick station is operating and using practically the same wave length as the San Diego station.

The coil aerials used in the experiments made with the system above described were but 4 ft. square and therefore merely form a part of the internal receiving apparatus and in no way complicate the simple tree system.

We have then a simple two-circuit receiving system requiring no extensive and costly outside aerial structure and have the following features: (*a*) Long-distance reception at any wave length. (*b*) Direction finder giving absolute direction. (*c*) Elimination of interference by virtue of the unidirectional characteristic. (*d*) Simultaneous reception of two or more wave lengths or of two similar wave lengths coming from opposite directions. In the experiments in tree telephony and telegraphy we may consider that we employ an aperiodic system in the form of the tree itself, and make use of the resultant potential effects at the upper tree terminal of this antenna, selecting from this reservoir of all frequencies the particular frequency desired, by means of external receiving devices now known to the art.

We may regard the metallic electrode rigidly driven into the living organisms of a tree as a potential earth-terminal for the study of the potential distribution on the surface of the earth itself. We may, indeed, by means of a highly insulated conductor bring this terminal directly to the laboratory and amplify almost at will the particular effects we are studying. The thermionic valve is a powerful instrument of research for the modern physical laboratry. Has not the physicist therefore in this electrode a means of studying in detail atmospheric and earth electrical disturbances? Methods and means of wireless art are now immediately applicable and available to the physical laboratory for the study of the fundamental problems of the earth itself as a charged sphere.

The physicist and engineer, accustomed to deal with inanimate material, is here confronted with the employment of living vegetable organisms of growing trees. From the moment an acorn is planted in fertile soil, it becomes a "detector" and a "receiver" of electromagnetic waves and the marvellous properties of this receiver, through agencies at present entirely hidden from us, are such as to vitalise the acorn and to produce in time the giant oak. In the power of multiplying plant cells, it may, indeed, be called an incomparable "amplifier."

From this point of view, we may consider that trees have been pieces of electrical apparatus from their beginning and with their manifold chains of living cells are absorbers, conductors, and radiators of the long electromagnetic waves as used in the wireless art. For our present purposes we may consider, therefore, a growing tree as a highly organised piece of living earth to be used in the same manner as we now use the earth as a universal conductor for telephony and telegraphy and other electrical purposes.

WATER POWER IN CANADA.

Some Recent Developments.

(*Continued from page* 317.)

In 1918 the shortage of power for essential war industries became critical, so an extension to the hydro-electric plant of the Ontario Power Co. at Niagara Falls, Ont., was undertaken as an emergency measure. The two other plants located at Niagara Falls on the Canadian side having reached their limit of capacity, the sole means of increasing the power supply, pending the completion of the Chippewa-Queenston development, was by the extension of the Ontario Power Co. plant. This work was commenced in March, 1918, and when completed will furnish an additional 50,000 h.p., the first 20,000 h.p. of which was to be ready by the end of January, 1919, and the remainder a few weeks later. The whole 50,000 h.p. will therefore have been made available in less than twelve months.

According to the *Canadian Engineer* of January 16th last, construction, which is being handled by the Engineering and Construction Departments of the Hydro-Electric Power Commission, involved the excavation of 133,000 yards of earth and 14,000 yards of rock to permit the erection of a 13.5-ft. diameter wood stave pipe, 6,700 ft. long; the fabrication and erection of a 13.5-ft. diameter steel distributor 179.5 ft. long, and of a steel differential surge tank, 60 ft. in diameter, and 94 ft. high; the installation of four valves, two penstocks each 10.5 ft. in diameter, and two new 20,000-h.p. turbines with direct connected generators, together with the necessary excavation for the building to house these units.

The installation is unique in several particulars. The wood stave pipe is one of the largest ever built; the differential surge tank has the greatest diameter, and its barrel is the highest, of any similar tank not equipped with an auxiliary spillway, while the design of the power house was governed by extraordinary conditions which necessitated protection against a 40-ft. rise of tailwater level.

The present plant of the Ontario Power Co. as now controlled and operated by the Hydro-Electric Power Commission, consists of an installation of fourteen turbines, seven with a rated capacity of 11,800 h.p., five rated at 15,000 h.p., and two at 16,000 h.p., making a total of 189,600 s.h.p. These are direct connected to generators with a total rating of 149,012 k.v.a. Water is supplied through two 18-ft. diameter conduits, each approximately 6,600 ft. long, having a combined maximum carrying capacity of about 162,000 h.p.

The first conduit, installed in 1903, was of steel plate encased in concrete, while No. 2 conduit, installed in 1910, was constructed of reinforced concrete 18 in. thick laid on a continuous concrete saddle. This second conduit, when inspected in April, 1918, after being in service eight years, showed no signs of cavitation or deterioration, although a velocity of 25 to 28 ft. per second had been maintained during operation. There was no vegetable growth whatever appearing on the walls; undoubtedly due to the high velocity of the water.

The third pipe line now being installed is 13.5 ft. interior diameter. The staves are B.C. fir, 4 in. thick by 6 in. wide. the pipe is banded with ¾-in. steel bands made in two sections with two shoes. The spacing of the bands varies, according to the pressure head, from 8¾ in. at the forebay end to 2¼ in. at the power house end.

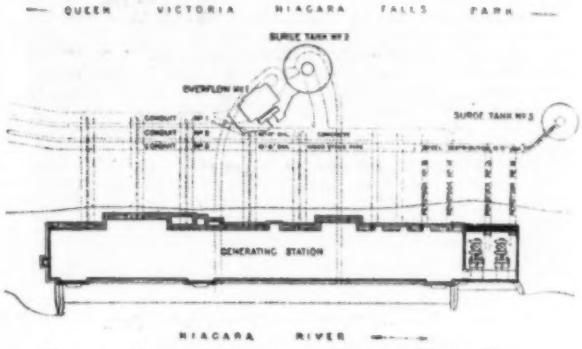

Fig. 9.—General Lay-out of Niagara Falls Power Station, Canada.

The gate house as constructed provided a 20-ft. diameter steel thimble projecting about 3 ft. Connection of the 13.5-ft. diameter wood stave pipe to this thimble is made by a taper section 25 ft. in length, built of reinforced concrete surrounding the thimble previously placed and ending in another steel thimble 13.5 ft. in diameter and 6 ft. long. The staves are lapped 18 in. over this plate, which projects about 2 ft. from the concrete envelope, and the connection is made when 1¼-in. bands are tightened on the staves.

The difficulties of excavation along the pipe line were varied, and in some places severe. At the gate house, and for 1,200 ft. below, the excavation was in rock. The construction of the pipe itself presented no particularly difficult problems.

The saddles used to support the pipe (fig. 10) are built-up timber sections so constructed as to make a continuous form for the lower half of the pipe. The outward thrust along the horizontal diameter of the pipe, caused by the tendency of the pipe to flatten when filled with water under a low head, is taken care of by two ¾-in. diameter round rods. The rods pass around the lower half of the pipe, and the end reactions of the rods are carried to both sides of the saddle by means of cast-iron washers. The saddles were spaced at 4.5 ft. intervals, except in certain locations where the pipe is concreted in place. During the construction of the pipe these saddles served as a form for laying up the lower half of the pipe. It was necessary to provide ample drainage for the pipe trench on account of the bottom of the trench being below the water level in the Niagara river for a large portion of its length.

The wood stave pipe ends in the distributor, which is made of steel plate ⅜ in. thick, 13.5 ft. in diameter, and 179 ft. 6 in. long. To this distributor four penstocks are connected by means of bell-mouthed tees, built up of steel plate bent to shape, and riveted to the distributor. The distributor is completely encased in concrete and the surface of the park above it will be restored to its original condition. At the end of the distributor is a section of reinforced concrete pipe 13.5 ft. in diameter and 77 ft. long, joining the distributor to the surge tank. This reinforced section is laid on a horizontal curve with a short section of tangent, and at the end is turned upward in a 90 deg. bend to form a connection for the riser of the surge tank.

The surge tank is of the Johnson differential type. The surge-tank riser is fabricated of ½-in. plate with circular angles riveted to the shell to act as stiffeners to withstand the collapsing pressure when the surge in the riser is downwards. The bottom parts are formed of an annular opening 9 in. wide, since the diameter of the riser is 12 ft. and the diameter of the distributor at the elbow is 13.5 ft. This annular orifice is divided into eight equal parts, each 3.75 sq. ft. area, by the supporting brackets and spaces. Two of these ports at the short turn of the elbow will be blocked, since only 22.5 sq. ft. area is required for the load changes expected. Another series of port holes is provided about half way up the riser, the lower ports being located at the bottom of the

tank. Air is admitted to, and escapes from, the tank through an open space left between the top of the tank and the roof. An area of 100 sq. ft. is provided for this purpose. The bell-mouthed tees which connect the distributor to the penstocks are built up of 0.5-in. steel plates, and their fabrication was an exceedingly difficult piece of plate work.

Penstocks Nos. 15 and 16 deliver the water to the two new turbines in the power house. These penstocks are 216.2 ft. in length. They drop vertically 48.3 ft., then turn through a 45-deg. elbow for 99-ft. tangent to another 45-deg. elbow, and from the lower elbow run out to the turbines in a horizontal plane. Each penstock ends in a supply pipe with two taper connections bolted to the spiral casings of the turbines. At the end of the supply pipe is located a

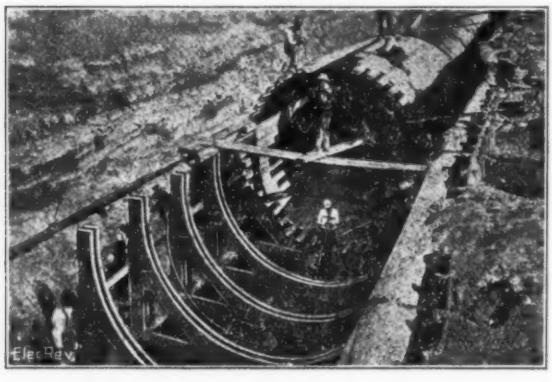

FIG. 10.—ERECTION OF WOOD-STAVE PIPE.

36-in. pressure regulator, which is directly connected to the turbine governor. Each penstock has a 16-in. drain discharging into the draught tube. The penstocks were designed to carry a pressure equal to 150 ft. head of water at the upper end, increasing to 320 ft. at the lower end at the entrance to the turbines. Allowance for the pressure rise due to a turbine gate closure time of 3 sec., with relief valve closed, has been included in the pressure limit. From the distributor trench to the power house the excavation for the two penstocks was entirely in the tunnel, and consisted in each case of a vertical, an inclined, and a horizontal section.

The water wheels are double-runner, central-discharge turbines, with spiral casings, running at 187.5 R.P.M., and delivering 20,000 H.P. under 180-ft. head. The draught tubes are mounted in the concrete foundation of the power house, changing from a circular shape in a horizontal plane to a rectangular shape in a vertical plane, and reducing the height velocity of the water at point of outlet from the runner to a velocity of 4 ft. per sec. at point of outlet to the tail bay. The gates are operated by vertical servo-motors, which are in turn controlled by 60,000-ft. lb. actuators mounted on the gallery above the turbines, and equipped with distance speed controllers, hydraulic hand controllers, gate limiting device, over speed, shut-down device, manual speed adjuster, gate-opening indicator, and tachometer. The centrifugal elements are of the leaf spring type mounted directly on centrally located vertical speed shafts, supported on double race ball bearings, and projecting downwards centrally through the actuators to a position below the gallery floor, where they connect to a gear and belt drive off an extension of the main turbine shaft. Helical gear rotary pumps, delivering 62.5 gal. p.m., against 200 lb. pressure at 187.5 R.P.M. furnish the oil. These pumps are furnished with unloading valves of such design that when the pressure is up to normal, the unloading valves open, and the pumps discharge directly into the sump tanks at atmospheric pressure.

The power house is of concrete and steel construction, and the erection of the units was carried on coincidentally with the erection of the rest of the superstructure.

The normal level of the Niagara river below the Falls is at elevation 343, which means an average 10-ft. loss of head on the whole plant. In order to gain this head on the present extension, turbine units Nos. 15 and 16 were set 10 ft. lower than units Nos. 1 to 14 inclusive, previously installed. To protect the power house against a recurrence of the high water conditions which prevailed in 1909 which flooded the power house by breaking through the windows in the front wall, the window sills were raised and the walls strengthened. In subsequent extensions, including the present one, this elevation of sill has been maintained and the front wall designed as a retaining wall to take the full water pressure, which in the present extension is that due to 40 ft. of head.

A standard gauge track runs the full length of the power house, and continues up the side of the cliff, connecting with the International Railway at the top.

Ample drainage is provided for all parts of the power house structure. Two 10-in. centrifugal pumps are used, each driven by a direct-connected 35-H.P., 25-cycle, 220-volt motor, and has a capacity of approximately 1,500 gallons per minute. One pump takes care of the drainage, while the second is a spare.

Air for cooling the generators is supplied by centrifugal fans located in the power house. The air supply is obtained from outside the building through ducts leading from the lower part of the front window down the inside of the front wall to the air chamber beside the fans. Provision has been made at the inlet end of the air ducts, for taking the air, if desired, from the power house instead of from outside during the extremely cold weather.

The hydraulics of the plant are of more than ordinary interest due to the fact that each of the three pipe lines and surge tanks that have been installed differ considerably. No. 1 tank has very little capacity, and is of the simple tank type. Its only function is to limit the surge pressure on conduit No. 1 during load changes, and provides entrance to a spillway for discharge of water at times of load rejection.

No. 2 surge tank, of the Johnson differential type, was the first tank of this character ever built. It serves the double purpose of relieving pressure surges and furnishing or storing water during load changes while the velocity in conduit No. 2 is being accelerated or decelerated. It is also equipped with a spillway as an additional safeguard, to prevent spilling over the top at times of abnormal surge, and to limit the height which would have been required without this provision.

No. 3 surge tank is of the same type at No. 2, but has no spillway. Its design is such that full load rejection under the most abnormal conditions will not cause overflow.

During 1913 a series of tests were made to determine the hydraulic characteristics and carrying capacities. The results of these tests indicate some very striking facts regarding the relatively greater carrying capacity of concrete pipe as compared with riveted steel and also the exceedingly smooth surface that can be obtained with concrete if proper and careful construction methods are used.

The capacity of No. 3 conduit, which is of wood stave construction, is 2,750 cu. ft. per second, giving a velocity of 19.2 ft. per second in the pipe. There will be a total loss in

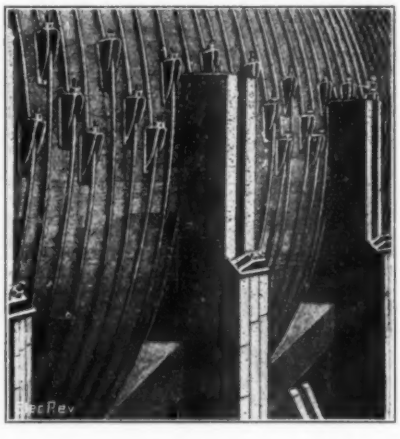

FIG. 11.—WOOD-STAVE PIPE SHOWING BANDS, SHOES, AND SADDLES.

the conduit, from gate house to penstock, of 32 ft., which includes entry losses, friction loss and velocity head. The capacity of the pipe will be approximately 45,000 turbine H.P. In comparing the coefficients of roughness of the concrete and steel pipes, as obtained by test, and the assumed coefficient of roughness for the wood stave pipe, based on the tests published by the U.S. Department of Agriculture, it appears that the concrete pipe has the highest coefficient, with the wood stave pipe a good second, and the steel pipe a poor third.

The function of the differential surge tank on conduit No. 3 is to regulate the velocity of flow during changes of load on the plant. Close speed regulation is essential to the success of modern hydro-electric plant. When load is rejected, the water surges into the tank riser until it has accumulated sufficient head to force the surplus water through the port holes at the base of the riser into the storage tank. It holds at this level while the velocity in the conduit is being gradually reduced by the retarding head, due to the difference in elevation of the water in the riser and the hydraulic gradient. In the meantime, the outer tank level is gradually rising, until at the end of the cycle the water levels in the outer tank and riser coincide, and a condition of equilibrium results. Following a demand for more power, the riser level drops sufficiently to allow the port holes to deliver the additional water from the outer tank, while the conduit velocity is accelerating to its new required value. It was, of course, necessary to design the tank for a drop

of full load on No. 3 conduit, under which condition the tank will receive all water without the provision of a spillway, and on the assumption that some of the pressure regulators on the turbines in the power house are in service. The condition of design for load thrown on, was that of an increment of load equivalent to a 20 per cent. velocity change from 80 per cent. up to full capacity of the conduit.

The wood stave pipe material was furnished by the Pacific Coast Pipe Co., of Vancouver. The turbines were originally built in 1914 by the S. Morgan Smith Co., of York, Pa., for the Southern Aluminium Co., for installation at Baden, N.C., on the Yadkin river development, and were purchased from the Aluminium Co. of America, which had taken over this development, and altered the plans before the installation of the machines. The Canadian General Electric Co., of Toronto, built the two generators.

The work was handled by the regular staff of the Hydro-Electric Power Commission of Ontario, of which Sir Adam Beck is chairman, and F. A. Gaby, chief engineer. H. G. Acres is hydraulic engineer; T. H. Hogg, assistant hydraulic engineer; M. V. Sauer, designing hydraulic engineer; E. T. Brandon, electrical engineer; A. H. Hull, assistant electrical engineer. A. V. Trimple is construction engineer, under whom

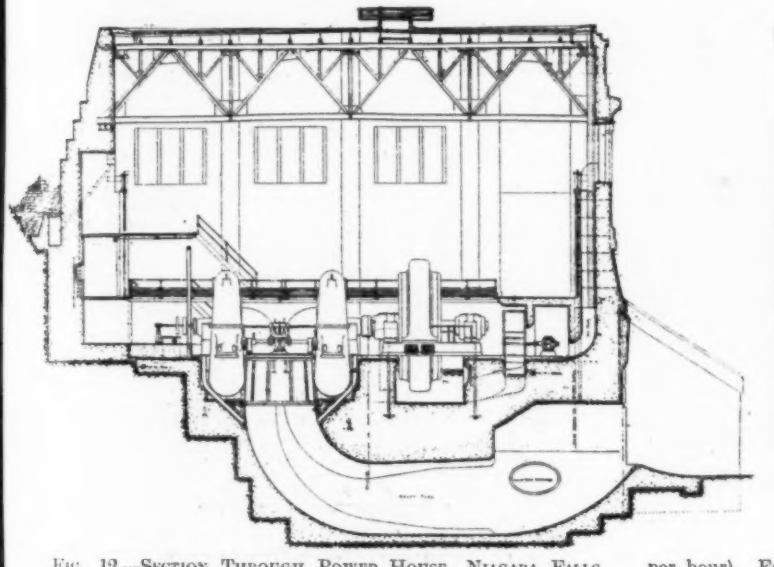

Fig. 12.—Section Through Power House, Niagara Falls, Canada.

J. F. McGraw is construction superintendent, and F. A. Burgar, assistant field superintendent. Walter Jackson is resident engineer.

(To be continued.)

Grants for Training.—The Appointments Department of the Ministry of Labour announces that the number of outstanding applications for professional training which have to be dealt with in the London district, comprising Kent, Surrey, Sussex, and Middlesex, is at the present time about 3,000. Fresh applications are being received at the rate of about 200 per week. Directions have now been received that all outstanding cases shall receive attention by the end of October. This will involve a large increase in the number of interviewing Boards, and also certain re-arrangements of the work of the London District Offices at Horrex's Hotel.—*The Times.*

Rock Removal by the Electric Arc.—The Southern California Edison Co. has carried out a series of experiments on rock removal for tunnel building, using A.C. and D.C. arcs and various types of gas torches, says the *Engineer*. It was essential that the arc should project considerably from the electrode tips. The three-phase arc having a greater density of magnetic field than either the single-phase or D.C. arcs, was found to project more than they did. The best current density for the carbon was estimated to be 44 amperes per sq. cm.—say, 284 amperes per sq. in.—for runs not exceeding 30 minutes, and 22 amperes per sq. cm. for continuous runs; 2-in. diameter carbons were supported on a holder which "shorted" or opened them uniformly to a maximum distance of about 2 in. From a cost point of view the best three-phase run was with 450 amperes per phase with 40 volts across the electrodes, and the amount of rock removed was about 1 lb. per minute of running time. This would be 450 × 40 × 1·73 × ·95 (p.f), or 29·58 KW., or at 1 per cent. per KW.-hour cost nearly ¼ cent—say, ¼d.—per lb. of rock removed. The single-phase arc did not show quite such good results in terms of kilowatts for lb. of rock removed. With D.C., 500 amperes at 30 volts, or 15 KW., removed 5 lb. of rock in five minutes, or at the rate of 1 lb. per minute. With the previous power cost assumption, this amounts to ¼ cent per lb. of rock removed.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Ediswan" Breakfast Cooker.

This cooker, fig. 1, as its name implies, has been specially designed to meet the growing demand for an effective, and at the same time inexpensive, apparatus for cooking light meals. It consists of two parts, namely, a griller and a boiling top. It will boil the kettle for tea or coffee whilst grilling the bacon, and there is ample space for plate-warming purposes. Strength and simplicity have been aimed at in the design. It is constructed throughout of cast iron finished black and relieved with bright mouldings. The boiling top is nickel; the whole cooker is quite easily cleaned. The overall dimensions are 9.75 × 8 × 12.5 in., whilst the size of the grilling space is 9 in. × 7 in. The boiling top is 10 in. × 8.25 in. Current consumption is low, the grill taking 1,000 watts (or 1 unit per hour) and the boiling top 750 watts (or 0.75 unit per hour). Each cooker is provided with a grilling pan and grid and two switches of the usual tumbler pattern. This cooker is being put on the market by the Edison Swan Electric Co., Ltd., Ponders End, Middlesex.

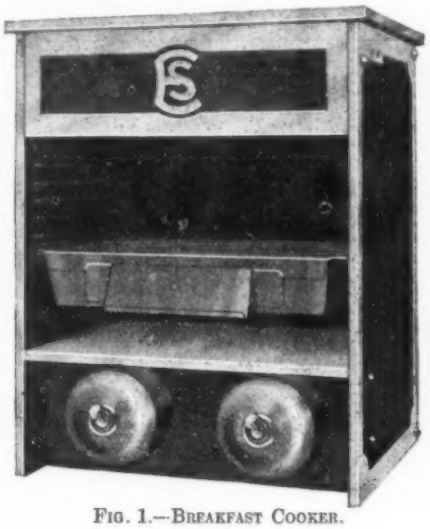

Fig. 1.—Breakfast Cooker.

A New Electric Battery Locomotive.

We give below some particulars of a new storage battery locomotive, of the Jeffrey Manufacturing Co.'s manufacture, of which Messrs. Hugh Wood & Co., Ltd., 65, Fenchurch Street, E.C.3, are sole agents for Great Britain, that recently underwent hauling and shunting tests at Manchester. The machine in uqestion, fig. 2, is fitted with 2 40-H.P. motors with centre cab control; it is designed for a track gauge of 56.5 in., the overall width of the locomotive being 8 ft. 8 in., the length over frame 16 ft. 5 in., and the height of frame above rail 58 in. The wheel base is 60 in., the diameter of the wheels 36 in., and the diameter of the axles 4.5 in. The chassis normally weighs about 20,000 lb., and the battery, composed of 220 A-6 Edison cells, about 5,000 lb., which brings the total approximate weight of the locomotive up to 12.5 tons.

The frame is made of structural steel, and the buffers and draw-bars are arranged to suit those of the cars that the locomotive is to haul. The driving steel-tired wheels are pressed on and keyed to open-hearth steel axles which are finished all over and without shoulders. The journal boxes have deep oil wells and ample room for packing, and the bearings are of bronze of sufficient size to be subject to no more than 250 lb. pressure per sq. in. The locomotive is arranged with inside wheels; the journal boxes are removable from the outside without dropping the wheels. The journal box lid is bolted to the journal box, and the inside of the lid is provided with hardened steel plate to take the end thrust of the hardened steel pin in the end of the axle. The brake is of the automatically locking screw type having sufficient braking effect to lock the drivers; the brake shoes are arranged to be readily accessible for removing and replacing. Straight air-brake equipment is provided. Four sand boxes fitted with positive acting self-closing valves are provided, and arranged to be operated in pairs by levers within convenient reach of the motorman.

The motors are of the enclosed multipolar type; the field frame is made of steel having laminated poles bolted to it. The field coils are insulated with mica and asbestos, completely enclosed in moisture-proof coverings, and impregnated with insulating compound. The armature is of the drum-wound type. The coils are placed in troughs of insulating

material in the slots in the armature core. Special treatment was given the armature windings to render them durable under the service they will be required to perform. The commutator bars are of hard drawn copper, insulated with mica of proper hardness to wear evenly with the copper. Arrangements for lubrication are conveniently accessible, and doors are provided in the motor frame for inspection of the brushes and commutator. All gears are of steel with involute cut teeth, enclosed in dust-proof cases and run in oil.

The controller is of the magnetic blow out type, and all parts are arranged for ready inspection and cleaning. The reverse and operating cylinders are interlocked so that the motorman cannot turn the reverse cylinder without first turning the operating cylinder to the "off" position, and cannot turn the operating cylinder from the "off" position until the reverse cylinder stands in one of the operating positions. A suitable switch is incorporated in the reverse cylinder, which has four running positions, viz., in series, ahead and reverse, and in parallel, ahead and reverse.

A "Sangamo" ampere-hour meter with plain circular dial and contact at zero, equipped with resetting device, for automatically operating a shunt trip circuit breaker for opening the circuit upon the completion of the charge is mounted on the locomotive. The locomotive is protected from dangerous over-

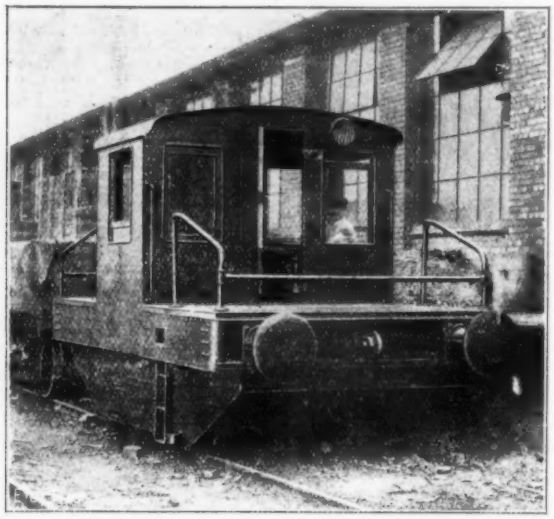

FIG. 2.—A NEW ELECTRIC BATTERY LOCOMOTIVE.

loads by an enclosed cartridge type fuse; it is wired with H.T. rubber-covered wires and cables and all controls are fitted in the all-steel cab located at the centre of the locomotive.

In the series of tests referred to the total distance run light was 1.36 miles, and on load 1.73 miles; 544 tons were moved, the ton-miles run amounting to 75.08. The total consumption reached 30 amp.-hrs., and the cost per ton mile, calculated on the basis of 1.5d. per B.T.U., worked out at 0.12d.

The speed of the locomotive in series is 1.5 M.P.H. and in parallel 5 M.P.H. The cost of charging the accumulators, 90 amps. at 210 volts for 6 hrs., or 113.4 B.T.U., at 1.5d. per B.T.U. equals 14s. 2d.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

20,830. "Receiving perforators." EASTERN ELECTRIC CO. August 25th.
20,830. "Extensible electric lamps for motors, &c., vehicles." B. J. Grigsby. August 25th.
20,877. "Electric lighting apparatus for cycles, &c." C. VON DER WEID. August 25th (Switzerland, September 19th, 1918.)
20,883. "Electric incandescent lamps." D. LELY and NAAMLOOZE VANNOOTSCHAP PHILIPS GLOELAMPENFABRIEKEN. August 25th.
20,885. "Electrical alarm or door security devices." K. KROSE. August 25th
20,892. "Electric switches." A. S. CUBITT. August 26th.
20,901. "Safety circuit breaker for overhead tramway wires." A. L. FINDLAY. August 26th.
20,902. "Eliminator of atmospheric discharge, &c., for wireless telegraphy." E. A. BITTON and A. H. BRANTON. August 26th.
20,904. "Emergency lamp for interior of motor head lamps, &c." B. S. EVANS. August 26th.
20,912. "Implement for use with automatic disk telephones." H. COOPER. August 26th.
20,920. "Storage batteries." W. H. DUGGAN and W. GARDINER. August 26th.
20,946. "Switch for closing electrical circuits." E. F. W. LEEDE. August 26th.
20,960. "Telephone exchange systems." G. DEAKIN and WESTERN ELECTRIC CO. August 26th.
20,983. "Microphones." W. K. L. DICKSON. August 26th.
20,986. "Electric ignition for internal-combustion engines." W. O. KENNINGTON. August 26th.
20,994. "Electric furnaces." T. A. D. LAWTON. August 27th.
20,995. "Hand-operated controllers for electric motors." R. G. CUNLIFFE. August 27th.
21,013. "Thief-proof high-tension switch for automobiles." V. C. E. MARTEN-GWILLIAM. August 27th.
21,025. "Telephone switch board and plug fittings." NAAMLOOZE VARNOOTSCHAP NEDERLANDSCH THERMO-TELEPHOON MAATSCHAPPIJ. August 27th, (Germany, August 27th, 1918.)
21,037. "Arc lamps for photography, &c." B. J. HALL and C. F. G. THORKELIN. August 27th.
21,049. "Electric kettles, &c." A. S. FORD. August 27th.
21,052. "Sparking plugs." B. D. BELLAMY and SUBURBAN MOTORS, LTD. August 27th.
21,056. "Magnetos." J. GORDON-HALL. August 27th.
21,067. "Operating mechanism for electric generators or magnetos." SPLITDORF ELECTRICAL CO. August 27th. (United States, January 16th, 1915.)
21,070. "Electric telegraph systems." WESTERN ELECTRIC CO. (Western Electric Co.) August 27th.
21,089. "Dynamo electric machines." BARON CLIFFORD OF CHUDLEIGH. (W. H. Clifford.) August 27th.
21,104. "Automatic excitation regulator for electric machines." J. T. IRWIN and A. RUSHTON. August 28th.
21,113. "Connectors for wires and electrical conductors." J. A. HALPIN. August 28th.
21,120. "Fly-wheel magneto devices for internal-combustion engines." F. POUNTNEY and VILLIERS ENGINEERING CO. August 28th.
21,124. "Apparatus for remagnetising magnetos." S. WOOD. August 28th.
21,151. "Wireless telegraphy, &c." WESTERN ELECTRIC CO. (Western Electric Co.) August 28th.
21,159. "Electric telegraph systems." C. P. RYAN. August 28th.
21,168. "Electric accumulators." J. H. RUNBAKEN. August 28th.
21,179. "Ignition magetos for internal-combustion engines." F. BOLIS FU G. B. STABILIMENTO GRECO MILANESE. August 28th. (Italy, September 17th, 1918.)
21,189. "Electrically controlled throttle, &c., valve in internal-combustion engine." P. V. POWELL and P. F. SMITH. August 28th.
21,190. "Magnetos." ARIOLI & Co. August 28th. (Italy, August 29th, 1918.)
21,199. "Apparatus for converting heat into electrical energy. F. E. Beeton. August 28th.
21,219. "Casings for electric storage batteries." M. AROSIO. August 28th. (Italy, August 28th, 1918.)
21,235. "Device for reducing effect of vagrant and interfering waves on wireless telegraphy receivers." F. J. LANE. August 29th.
21,258. "Galvonometers, &c." L. JOHNSON. August 29th.
21,272. "Electric cable mountings for use on motor vehicles, &c." R. W. MAUDSLAY and STANDARD MOTOR CO. August 29th.
21,293. "Regulating systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co.) August 29th.
21,312. "Ignition device for internal-combustion engines." R. A. WILLIAMS. August 29th.
21,322. "Dynamo electric machinery." T. L. R. COOPER. August 30th.
21,327. "Electric lamp holders, fitments, &c." W. PRESTON and W. SANDERS & Co. August 30th.
21,334. "Storage batteries." E. R. ROYSTON. (Federal Storage Battery Co.) August 30th.
21,340. "Moving brush gear." GRAFTON DYNAMOS, LTD., and W. F. GRAFTON. August 30th.
21,342. "Electric arc furnaces." A. P. HEYEN. August 30th.
21,363. "Combination locking device for switches of magnetos of motor vehicles." S. ELION. August 30th.
21,392. "Railway traffic controlling systems." MCKENZIE HOLLAND & WESTINGHOUSE POWER SIGNAL CO. August 30th. (U.S.A., May 21st, 1918.)

PUBLISHED SPECIFICATIONS.

The numbers in parenthesis are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

1,301. INCANDESCENT ELECTRIC LAMPS. A. McCullum. August 22nd, 1918. (130,625.)
3,480. COMBINATION OF TELEGRAPH AND TELEPHONE APPARATUS. L. E. Austing. February 27th, 1918. (130,641.)
3,496. DYNAMO ELECTRIC MACHINES. G. Plaisant. June 22nd, 1917. (Divided application of 18,387/16.) (130,642.)
3,497. DYNAMO ELECTRIC MACHINES. G. Plaisant. June 22nd, 1917. (Divided application of 18,387/16.) ((130,643.)
3,721. MEANS FOR STARTING INTERNAL-COMBUSTION ENGINES. Vickers, Ltd., J. Etchells and C. H. Stedman. March 2nd, 1918. (130,655.)
3,722. SWITCHES FOR CONTROLLING ELECTRIC MOTORS. Vickers, Ltd., J. Etchells and C. H. Stedman. March 2nd, 1918. (130,656.)
3,913. ARC LAMP. L. Mauclaire, A. Garbarini and G. Gautier. October 13th, 1917. (130,663.)
4,057. VARIABLE CONDENSERS FOR WIRELESS TELEGRAPHY AND TELEPHONY. W. H. Edbridge and E. E. G. Boite. March 8th, 1918. (130,667.)
4,333. INDUCTIVELY UNTAPPABLE TELEGRAPH. A. H. Morse. March 12th, 1918. (Cognate application 5,798/18.) (130,679.)
4,419. ELECTRIC SWITCHES. Siemens Schuckertwerke. January 20th, 1917. (114,161.)
4,527. MOUNTING ELECTRODES OF ELECTRIC FURNACES. C. C. Gow. March 14th, 1918. (130,687.)
4,758. DYNAMO ELECTRIC MACHINES. G. Plaisant. March 18th, 1918. (Addition to 18,387/16.) (130,700.)
4,841. ELECTRIC ARC FURNACES. British Thomson-Houston Co. and J. J. Ash. March 19th, 1918. (130,703.)
7,693. ELECTRIC HEATING QUILTS, BLANKETS, OR THE LIKE. R. O. de K. Hall and H. A. Duxbury. May 8th, 1918. (130,710.)
11,076. MAGNETOS. Splitdorf Electrical Co. December 1st, 1916. (118,996.)
12,551. SPARKING PLUGS FOR USE WITH INTERNAL-COMBUSTION ENGINES. J. E. Barrows. August 1st, 1918. (Cognate application 317/19.) (130,734.)
12,669. CONSTANT CURRENT DYNAMOS. Trier & Martin, V. A. Trier and S. Smith & Sons. August 2nd, 1918. (Addition to 1,652/10.) (130,740.)
12,670. ELECTRIC TRACTION SYSTEMS EMPLOYING A CENTRE GRIPPING RAIL. G. N. Fell. August 2nd, 1918. (130,741.)
12,707. IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. A. H. Midgley and C. A. Vandervell & Co. August 3rd, 1918. (130,749.)
12,749. ELECTRIC ACCUMULATORS OR STORAGE BATTERIES. J. F. Hutchinson. August 6th, 1918. (130,752.)
12,828. RECORDING APPARATUS FOR ELECTRIC CURRENT IMPULSES. British Thomson-Houston Co. (General Electric Co.) August 7th, 1918. (130,762.)
12,900. LOCALISING APPARATUS FOR USE WITH X-RAYS. E. C. Roberts. August 8th, 1918. (130,773.)
13,036. MANUFACTURE OF ELECTRODES FOR SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC. Alloy Welding Process, Ltd., and E. H. Jones. August 10th, 1918. (130,782.)
13,231. PROCESS FOR ELECTROLYTICALLY SEPARATING NICKEL FROM COPPER. G. A. Guess. August 14th, 1917. (118,629.)
14,235. ELECTRIC ARC FURNACES. J. Bibby. September 2nd, 1918. (130,816.)
15,508. FIELD MAGNETS OF DYNAMOS AND MOTORS AND THEIR METHOD OF CONSTRUCTION. G. Kent, Ltd., and A. H. Avery. September 24th, 1918. (130,835.)
15,700. TELEPHONE APPARATUS FOR USE ON ONE COMMON LINE. Aktieselskabet Elektrisk Bureau. November 15th, 1917. (120,720.)
16,918. SYSTEMS OF ELECTRIC MOTOR CONTROL. British Thomson-Houston Co. (General Electric Co.) October 16th, 1918. (130,850.)